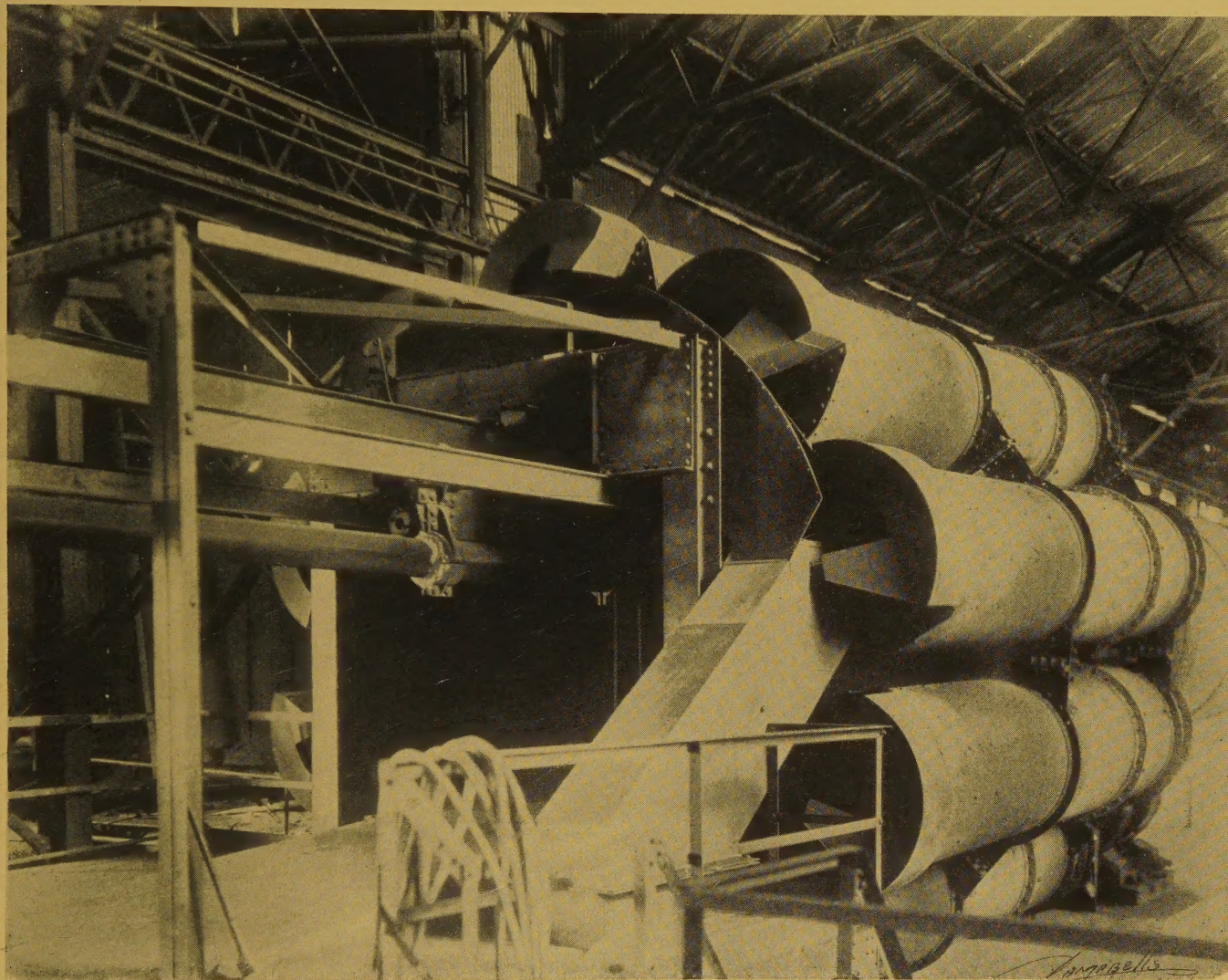


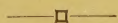
MILL SECTION of
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UNAX COOLER

(Patented)

For Rotary Kilns

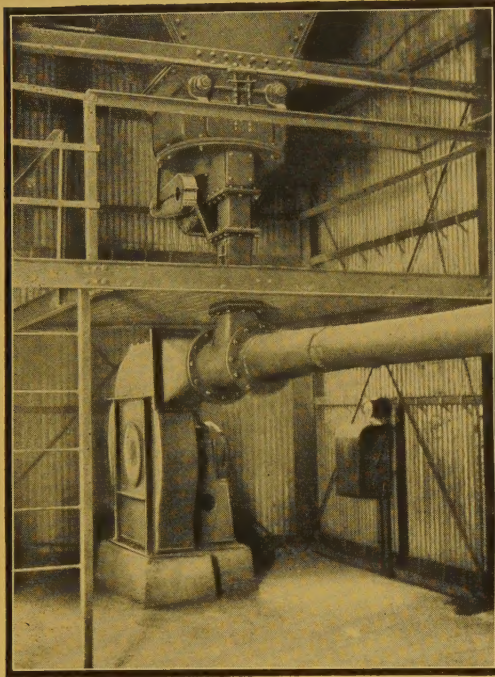


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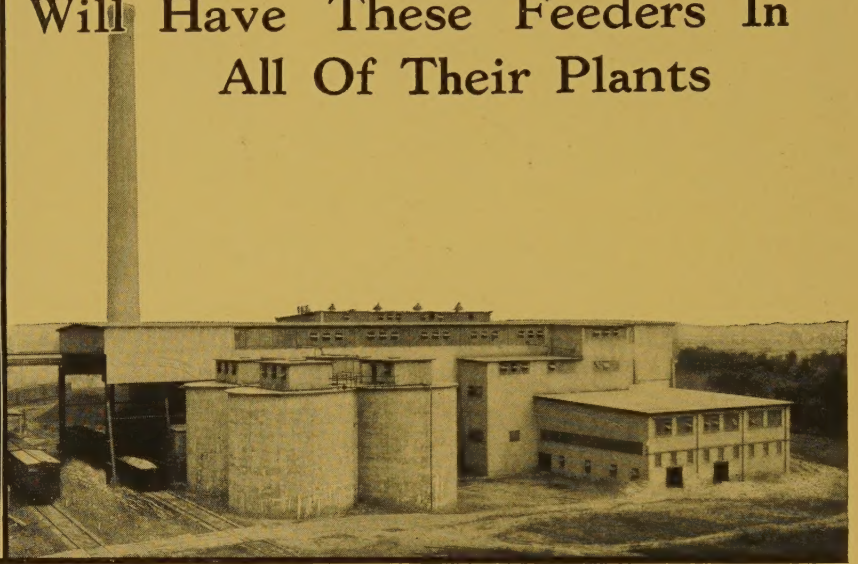
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Twelve More Bailey Feeders For Rotary Kiln Firing —



Medusa Portland Cement Co.
Will Have These Feeders In
All Of Their Plants



Due to the highly satisfactory service rendered by twelve Bailey Pulverized-Coal Feeders in the plants of the Medusa and Petoskey Portland Cement Companies, twelve additional Feeders have been purchased.

The use of Bailey Feeders for firing Rotary Kilns has resulted in the production of more uniformly burned cement clinker with lower fuel consumption. That Bailey Feeders are preferred by engineers because of this advantage is evidenced by the 87 Feeders now in operation or process of installation in 35 plants of 27 different cement companies—and 15 cement companies are using Bailey Feeders exclusively for firing their kilns.

A Bailey Feeder installation soon pays for itself, not only in fuel economy, but also in improved quality of product. Ask us to tell you more about the Bailey Feeder.

1-168

FULLER LEHIGH COMPANY, FULLERTON, PENNA.—A BABCOCK & WILCOX ORGANIZATION

FULLER LEHIGH

PULVERIZED-COAL EQUIPMENT—WATER-COOLED FURNACE WALLS—ELVERITE CASTINGS

Index to Advertisers on Page 99 of This Section

MILL SECTION of Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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February, 1930

Number 2

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Years of specialization in meeting cement mill requirements have enabled us to develop a line of grinding bodies which are unusually well suited to the conditions which exist in cement plants.

**We meet your requirements in
QUALITY, EFFICIENCY
and PRICE**

Some of our grinding bodies are very low in price, and some comparatively high; but service considered, every slug or ball we have to offer is economical for the purpose it is intended to serve.

Our line includes all sizes of balls and slugs as follows:

CARBEX FORGED STEEL BALLS— $\frac{7}{8}$ -in., 1-in., $1\frac{1}{4}$ -in., $1\frac{1}{2}$ -in., $2\frac{1}{2}$ -in., 3-in., $3\frac{1}{2}$ -in., 4-in., 5-in. diameter.

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If you will let us know what your grinding requirements are, we shall be glad to submit prices on same. We carry ample stocks and can make prompt shipments.

Coates Steel Products Co.

**[[Largest Manufacturer of
Grinding Media Exclusively]]**

Greenville, Illinois

Concrete

Vol. 36

Chicago, February, 1930

No. 2

Where "Longhorn" Cement Is Made

Some Particulars Regarding the New Plant of the Republic Portland Cement Co., at San Antonio, Texas

IN September, 1928, grinning darkies were picking cotton from a field twelve miles northeast of San Antonio. They paused in their work to gaze at khaki-clad engineers who were engaged in staking out the location for what was to be one of the finest cement mills in the country.

In August, 1929, the first shipment was made from the 3,600 barrel mill which had reared its stacks to completion in less than a year's time!

A Favorable Location

Those responsible for the organization of the Republic Portland Cement Company had very definite objects in view when they chose San Antonio as the location for a major Texas cement mill. First, San Antonio is the center of a tremendous and rapidly growing trade territory. It is 100 miles closer to the Rio Grande valley of Texas than any other large city and is the natural and geographic key point from which to supply that section. It is 100 miles closer to Corpus Christi, a fast developing port whose business interests are very closely related to San Antonio. Austin, the state capital, is but seventy-five miles to the north. Then, too, San Antonio is one of the largest cities in Texas and is more than 200 miles from any rival business center. It is also the gateway to that section of Texas which is now developing rapidly and which gives greatest promise of future development.

The city of San Antonio is in itself a tremendous present and potential market. San Antonio building permits total approximately 15 million dollars annually. Government activities call for the expenditure of many millions of dollars each year for improvements. Some 25 million dollars have been appropriated and work is now in progress on the Army's largest flying center.

The location of the plant with regard to San Antonio itself has also had careful consideration, the site finally selected being the maximum distance from the city which still permits inbound cars to move on a switching basis.

In addition, it is served by two main-line railroads and the plant is within easy trucking distance of the city over two hard surfaced roads.

Some Unusual Features

Features of this plant which set it apart from ordinary construction are: no overburden in quarry; quarry and crusher plant placed on same level; a single hammer mill

takes care of all the crushing; minimum of rehandling; and gas fuel which does away with the coal mill and its accompanying machinery.

The mill construction is characterized by the extensive use of concrete which has resulted in an unusually small amount of steel structure. The buff colored walls with red corrugated cement asbestos roofing make an unusually pleasing appearance.

The land is gently sloping with a total difference in elevation of 125 feet. The mill itself is located on a rise of about 35 feet from the substation at the south to the stacks at the north end. The office and laboratory are housed in separate mission type buildings on a hillside west of the plant. The laboratory is comfortably spacious and among the equipment is an Olsen 300,000-lb. testing machine.

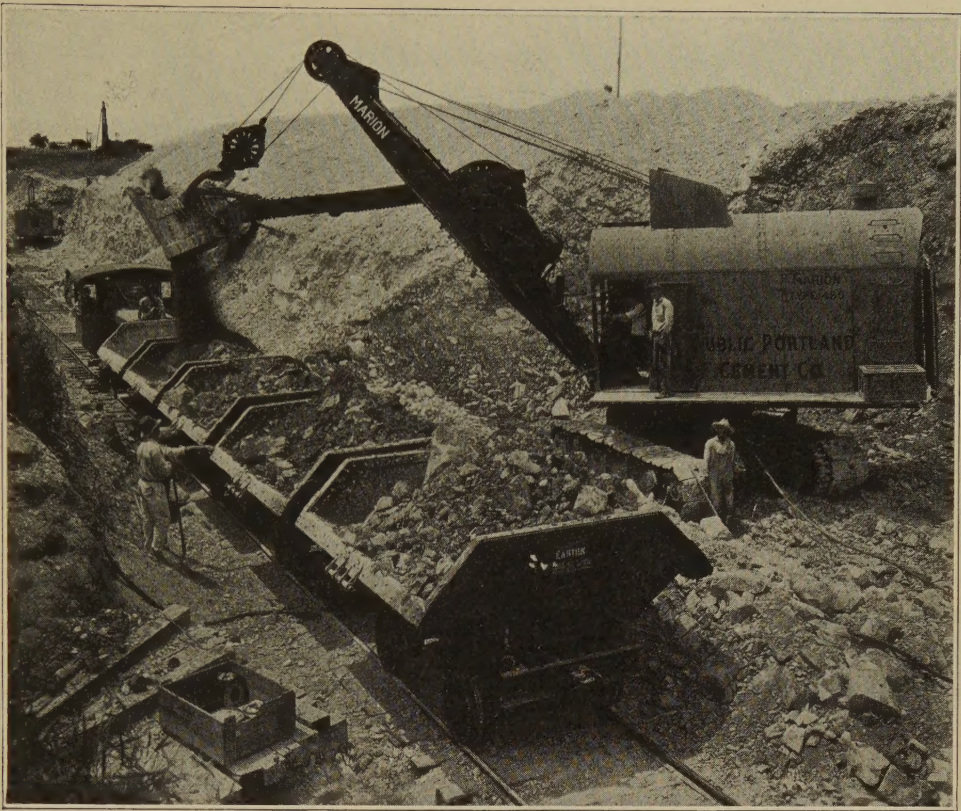
Raw Materials

The mill is on the low land on the south side of the property and quarrying operations extend northward into the hill. The total area of the property is approximately 475 acres. Raw materials on the property consist of an argillaceous chalk varying from soft earthy to fully solidified material. For the most part the material is soft and can be easily ground. The amount of overburden over the chalk is nowhere great, having an average depth from two to three feet. Geologically, the material belongs to the Austin chalk, one of the lower members of the Gulf series of the Upper Cretaceous period, which outcrops in a narrow band from the Red River to the Rio Grande. Since the high lime, cement rock and low lime are found in the exposed strata, only one working face is required.

In chemical composition the material ranges from a calcareous clay containing about 30 per cent carbonate of lime to a fairly pure chalk containing 92 per cent carbonate of lime. Difficulty of haulage is minimized because the quarry floor is practically on the same elevation as the crusher house. Much of this material is of correct composition in order to make satisfactory portland cement other than the gypsum required to regulate the set which is added after burning. Ten hours of quarry operation will maintain the rock supply for twenty-four hours of mill operation.

According to the estimates of Dr. Richard K. Meade, sufficient raw materials have already been blocked out to

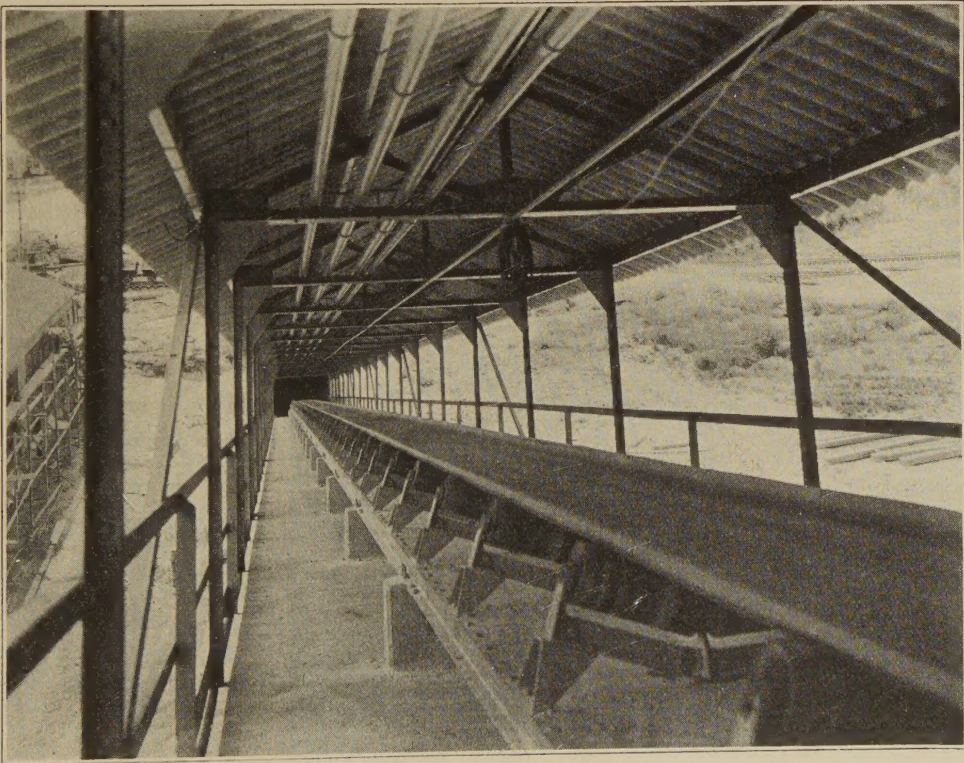
Steel dump cars transport rock from the quarry to the crushing plant. They have capacities of 8 cu. yds. and are handled by a gasoline locomotive at the Longhorn plant



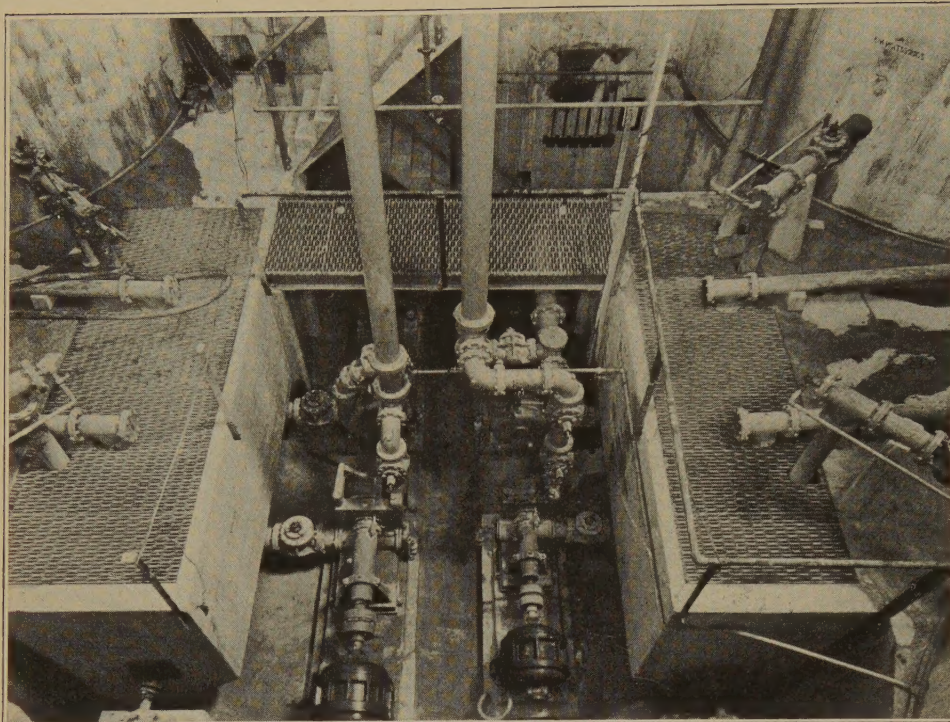
These compeb mills, which grind the rock wet in one operation to the fineness now recognized as requisite for manufacturing cement of the highest quality, are 8 by 7 by 40 feet.

From these mills the slurry flows into a mechanically

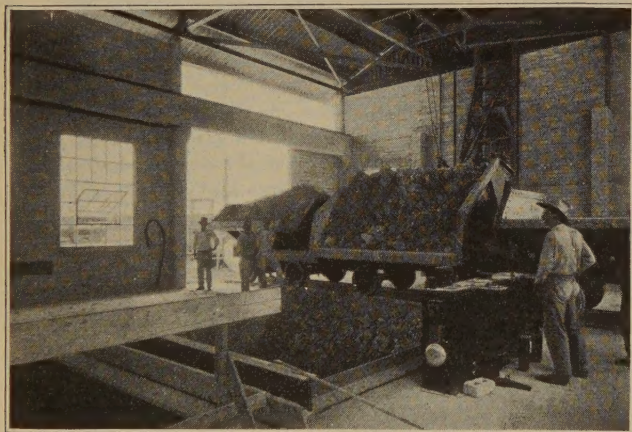
agitated sump. Two centrifugal slurry pumps, one operating and one reserve, deliver the slurry from the mill pump to the slurry tanks. The slurry tanks are ten in number, 6 receiving tanks 20 feet in diameter and 30 feet high, and 4 feed tanks 24 feet in diameter and 30 feet high, and are



The inclined belt conveyor for crushed stone, leading from the crushing to the main plant



The slurry is delivered from the mill pump to the slurry tanks by these pumps. One is operating; the other reserve



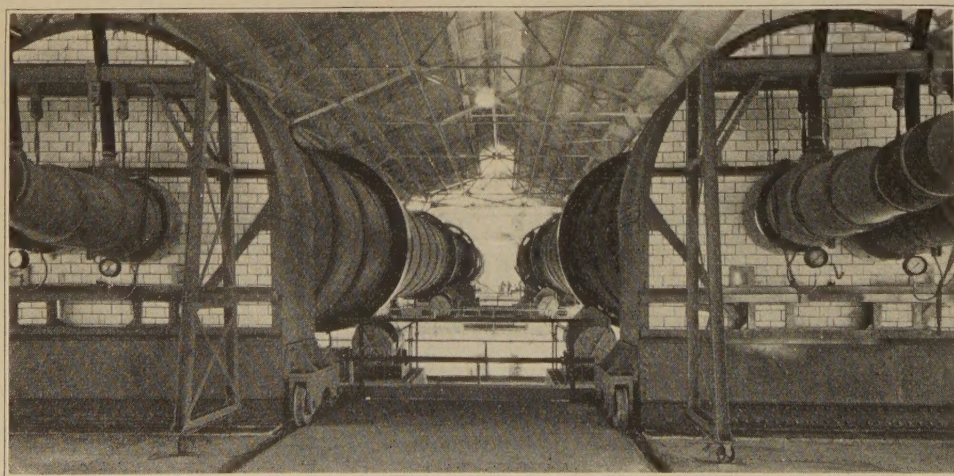
The hammer-mill installed reduces material to a maximum size of three-quarters of an inch at the rate of 250 tons per hour. It is equipped with movable breaker plate

arranged about a central pump pit where 4 centrifugal type pumps are arranged so that one pair may be utilized for transferring the slurry between the various tanks while the other pair is used for delivery of the slurry to the kiln feeders.

Kilns

These kiln feeders are of the ferris wheel type and are driven from variable speed motors operated from the kiln burning deck. Natural gas fires the kilns, which is received at 200 lbs. and gradually reduced to six ounces at the burner.

The kilns are 11 feet in diameter by 250 feet long and are carried on four riding rings with two-roller type supports. The kilns are driven by variable speed, direct current motors which are connected to the kilns by a gear unit for reducing the motor speed to the slow rotating speed of the kilns. The burning ends of the kilns are lined with high alumina fire brick, with intermediate and



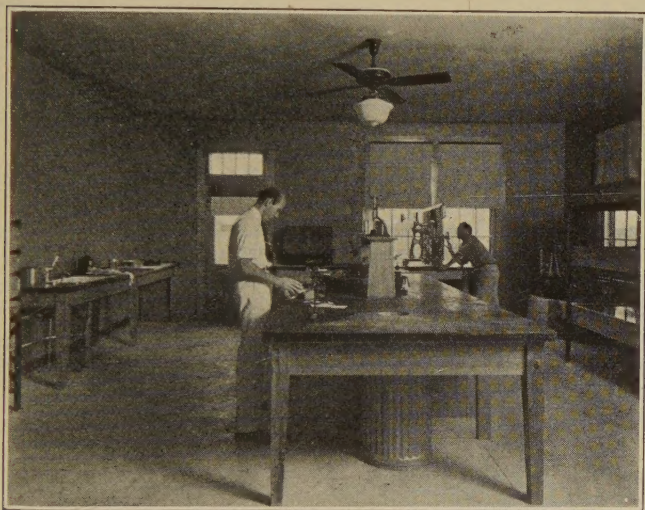
The Republic Portland Cement kilns. They are driven by variable speed, direct current motors connected by a gear unit for reducing the motor speed. Burning ends are lined with high alumina fire brick

ordinary fire brick through the remainder of their length to the feed ends. Provision has been made for oil burning in the event of gas shortage. The kilns are roofed to protect them from the weather and are provided with a dust chamber and concrete stacks 200 feet high with 9-foot flues. The burning deck is free from apparatus, only the blower, the control panel and the gas manifolds being visible.

The firing blowers are mounted on the burning deck at the discharge end of the kilns, along with the electric panel boards carrying the control switches for regulating at one point both the rate of feed into the kilns and the kilns' speed of rotation.

Clinker Handling

Burned clinker drops from the kilns directly into two rotary coolers, each 10 feet in diameter by 100 feet in length and provided with the most modern arrangement of heat resisting lifting plates. The discharge ends of the coolers are in line with one side of the storage structure so that discharged clinker drops directly into a pit under the craneway, eliminating the necessity for any mechanical conveyor for the clinker.

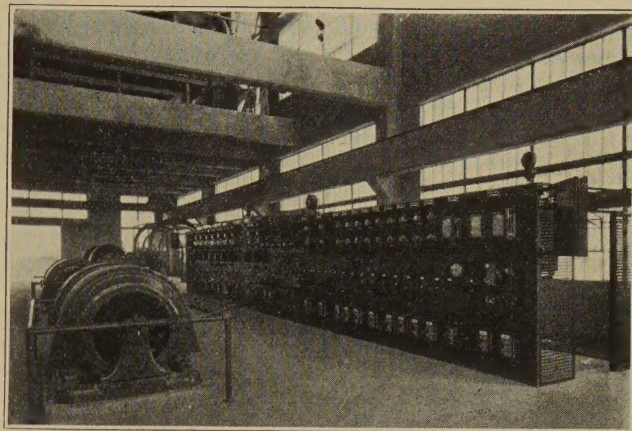


The laboratory is uncrowded. Among the equipment is included an Olsen 300,000 lb. testing machine

The clinker pit is located opposite the feed bins serving the two dry grinding mills and is served by the same traveling crane as the raw storage, since only a cross division wall separates the two. A track for gypsum runs alongside the clinker storage adjacent to the clinker feed bins where suitable gypsum storage and feed bins are provided. The clinker and gypsum feeders are of the rotating table type, similar to those in the raw mills, but smaller in size. The dry or finish grinding mills are 8 by 7 by 40 foot compeb mills, and all four grinding mills are each driven by an 800 horsepower super-synchronous motor.

The main mill building also houses the electrical switchboard and approximately 75 per cent of the motor horsepower for the entire plant, thus providing a central electrical control room and an unusually efficient concentration of motor equipment. In the same mill room are the motor generator sets for supplying low pressure air for the agitation of the slurry tanks and high pressure air for operating the finished cement pumps.

These pumps are located beneath the deck of the mill house and the finished cement is delivered to them from the mills by a screw conveyor and through screens.



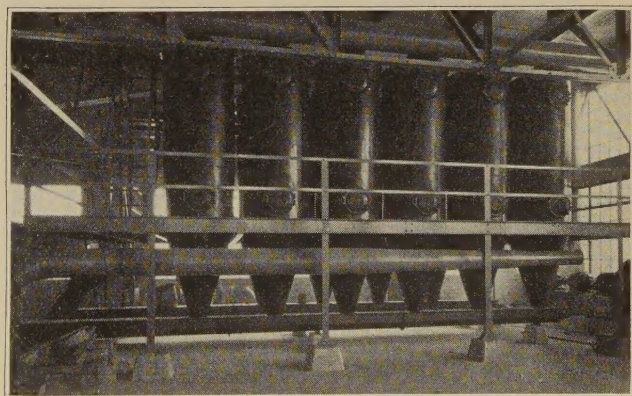
The electrical switchboard and about 75 per cent of the motor horsepower for the entire plant is located in the main mill building

Finished Cement Handling

The finished cement delivery lines pass from the mill room across the tracks and the main service roadway to the storage structure. This storage structure is of concrete construction and of the silo type and has a capacity of 150,000 barrels. At one end of the storage structure is located the four-story pack house which is of the most modern design and arrangement.

The discharge conveyors from the silos will deliver the cement to two elevators in the basement of the packhouse which in turn deliver the cement to the automatic weighers and packers. From these, conveyor belts are arranged for simultaneous delivery of sacks to cars on either side of the building. There is also a conveyor and a spout for delivering bulk cement at the same time to a car on a third track alongside. In the packhouse are a bag cleaning wheel, sorting belts and tables, full dust collecting equipment, an elevator which serves the various floors, and ample storage space for empty sacks.

An ideal track arrangement provides storage track



View of the dust-collecting equipment being used at the Texas plant

above the packhouse for fifty cars and each of the two loading tracks with run-around tracks so that the railway may serve these empty storage tracks without disturbing the loading tracks at the packhouse. The arrangement will easily permit enlargement of empty car storage.

Adjacent to the main mill building housed in one structure are the machine shop, electrical workshop, storeroom and locker, wash and change rooms for the workmen.

The Village of "Longhorn"

On the west hill is located the village of Longhorn,

which can accommodate about 120 families. Wards are maintained for white, Mexican and negro employees. Neat frame houses, each with plentiful lawns and shrubbery, and gas, water and electricity furnished from the mill provide happy living conditions. A company-owned com-

preferred stock was recently retired, and there is no bonded indebtedness.

Dewey Plans \$500,000 Additions to Plant as Its Contribution to National Building Program

An expansion program that will entail the expenditure of between \$500,000 and \$600,000, and will necessitate the employment of 185 additional men during the next few months will be the contribution of the Dewey Portland Cement Co. to the continued development of the Davenport (Iowa) community during 1930.

"In adopting this program we are attempting to help carry out the state-wide policy suggested by the governor," F. E. Tyler, president of the company, stated in a recent interview.

"This program will make it necessary to employ 185 men during the next few months, which number is in addition to the 250 continuously employed at the Davenport plant.

"The program will consist of the following: The building of 200,000 barrels additional storage for cement, installation of a clay wash mill, installation of a system of filters which will reduce the cost of operation of the plant by enabling the kilns to burn more clinker with the same amount of coal, and the installation of a thickener and classifier system."

Four Leading German Manufacturers to Merge

Four German companies, controlling 50 per cent of the country's portland cement production, have agreed to combine, independently of the Cement Syndicate.

The firms which have signed the new agreement are: Dyckerhoff and Sons' Portland Cement Factory at Mayence; E. Schwenk Cement & Stone Works at Ulm, on the Danube; the Heidelberg & Mannheim Portland Cement Works in Heidelberg, and the Silesian Portland Cement Industry Co. in Oppelin.

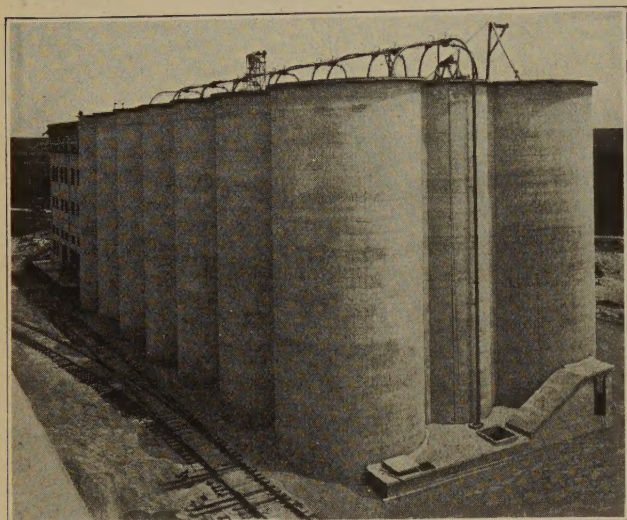
The Silesian Portland Cement Co. has a capital of 27,000,000 mks. and has paid a dividend of 12 per cent for each of the past two years. The Heidelberg Portland Cement Works has a capital of 30,000,000 mks. and has paid 10 per cent for 1927 and 1928. The other two companies are similarly prosperous.

"The German Cement Syndicate is practically in process of dissolution, as its chief member, the Wicking group, is tired of contributing to the cost of fighting outsiders and considers that, with its thoroughly rationalized works, it can crush outsiders better than if it were bound up with the syndicate. The Wicking group is not on too good terms with the new amalgamation," European dispatches state.

"It is known that the companies comprised in the new combine are as efficiently rationalized as the works of the Wicking concern, and that their plant is very modern. It is announced that a foreign financial group, believed to be American, has arranged to establish portland cement works in Germany and also in some unnamed adjoining country, which will be equipped with the most modern plant," it is stated.

Alpha Dividend

The Alpha Portland Cement Company, New York City, declared a regular quarterly dividend of 75 cents on common stock, payable January 15th to stock of record of December 30th.



The 150,000 bbl. storage structure is supplied by delivery lines leading to it from the mill room across the tracks and the main service roadway

missary provides supplies at prices comparable to those charged by chain stores.

It is significant to note that the quarry and crushing units as well as the grinding mills for both the raw and finished ends of this mill are sufficiently over-sized to permit the installation of a third kiln and that the general space arrangement of the plant is such that raw or finishing mills as well as other major equipment can be added to the mill of the Republic Portland Cement Company without conflict.

United States Steel Purchases Atlas; Combines with Universal

Announcement was made early in January that the business of the Atlas and the Universal Portland Cement companies is now conducted by the Universal Atlas Cement Company, subsidiary of the United States Steel Corporation.

The announcement further stated that "The Atlas and Universal organizations are brought together through the Atlas sale to the United States Steel Corporation of which the Universal company is a subsidiary.

"The Atlas and Universal companies have grown up with the cement industry. Each is a third of a century old. The same general policies under which they have operated continue.

"Plants of Universal Atlas Cement Co. are at Hudson, N. Y.; Northampton, Pa.; Universal, Pa.; Buffington, Ind.; Duluth, Minn.; Hannibal, Mo.; Independence, Kas.; Leeds, Ala., and Waco, Tex.

The new company will thus produce Atlas portland cement, Universal portland cement, Atlas White portland cement, and Atlas Lumnite cement.

The entire transaction involved 180,000 shares of United States Steel common stock in return for the outstanding stock, entire assets and good-will of the cement company, or an exchange of stock on a basis of one share of Steel for five shares of Atlas. Beyond its common stock the Atlas company's liabilities were said to be negligible. The

Necessity of Uniform Feeding of Dry Pulverized Materials

Improved Methods of Feeding Pulverized Coal Should Be Applied to Dry Ground Raw Materials—Evils of Uneven Feeding

By H. A. SCHAFFER

CAREFUL observation of kiln operation over a period of thirty years has shown the importance of the uniform feeding of both pulverized coal and raw mix. Uneven feeding of either material causes burning conditions in a rotary kiln which prevent the normal production of a uniformly burned clinker at the minimum number of pounds of coal per barrel.

From the standpoint of fuel, these conditions do not exist in kilns where oil or gas are used, as those fuels are always under positive control; but in practically every rotary kiln operation in which pulverized coal was used feed screws were employed prior to the introduction of the Bailey feeder.

The same screw feeder is universal in conveying dry raw mix into kilns and is one of the reasons why the dry process kilns in the past have not produced as uniform clinker as that made by the wet process. This was not entirely due to better blending, but partly because the wet raw material or slurry was fed uniformly to the kilns. This, of course, refers to the years of operation before the introduction of blending bins for the intimate mixing of dry ground raw materials.

The fact remains however, that feeders of the screw type cannot be relied upon to deliver a definite quantity of pulverized material; and in the case of coal, they transmit to the burner pipe fluctuations in the consistency of the material in the overhead storage bin. These fluctuations are due to many variables, which may be described as follows: Intermittent feeding to bins, due to periodic coal plant operation, which prevents keeping the bins filled to a constant level; incorrectly designed bins to which feeders are attached; arching over the screw and the formation of "rat-holes," which are caused by moisture in coal and compactness of this light-weight, finely divided material; cascading in the so-called "rat-holes" when the material breaks away and rushes down to the feeder.

Causes of Flooding

These conditions cause flooding of the powdered coal, which even double-flighted screws in narrow conveying troughs or tight fitting pipes fail to stop. The results of only occasional flooding are disastrous to the continuous operation of any kiln, production is interrupted, while fuel consumption per barrel is increased.

For a long time too little attention was given to the proper design of pulverized coal bins. The hoppers or bottoms of such bins were usually too flat, causing the material to pack and arch over the screw. It has been found that free feeding can be facilitated by having the sides of the hopper at an angle of 70 deg. with the horizontal, for with the rivets countersunk on the inside of the bin, the angle is steep enough to prevent the mass of pulverized coal from arching or bridging over.

A Bailey feeder connected to a hopper of the above design assures the operator of a constant uniform coal feed, eliminates flooding and results in better control over



A Bailey pulverized coal feeder installation

combustion conditions in the kiln than is possible with any screw feeder.

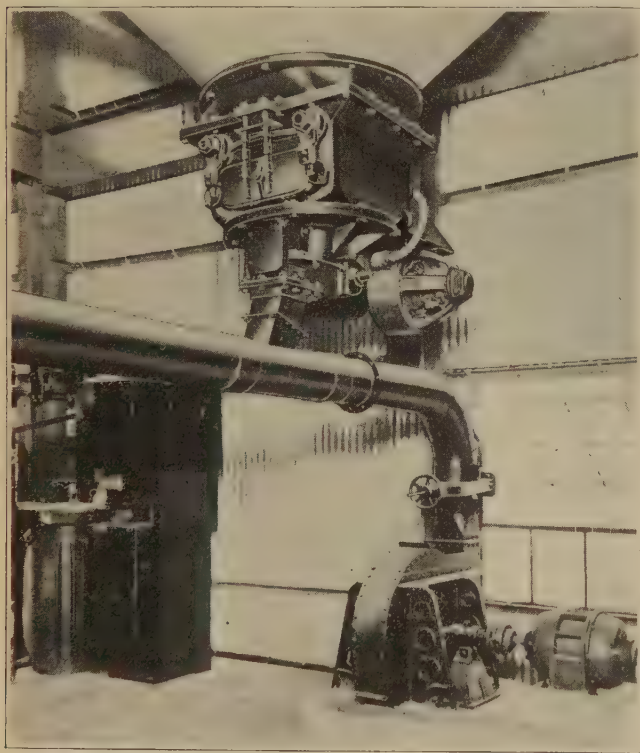
Feeder Operation

This apparatus was first installed on pulverized coal-fired boiler furnaces. Operating on an entirely different principle from the screw type of feeder, which was first adopted from earlier installations observed in the cement industry, the Bailey feeder was found by numerous tests to deliver a definite quantity of fuel to the furnace and resulted in higher capacity with better evaporation per pound of fuel than was previously possible with the screw

feeder. Furthermore, the revolution counter connected to the feeder wheel was shown to be a reliable meter of the quantity of coal used, correct within two per cent, which was an added advantage over the original method of feeding the pulverized coal to boiler furnaces. In some plants, scales for weighing coal as received were installed, but this was the only means of checking railroad weights, as revolution counters on feed screws delivering pulverized coal or other materials from overhead bins have not proved satisfactory as meters of accuracy.

The Bailey feeder has a large rectangular compartment at the top, which is connected to the bottom of the storage bin. The size of the opening is such that the pulverized coal will not form an arch, particularly with the normal weight of coal carried in the storage bin. In the bottom of this compartment, a rotary two-arm distributor prevents the coal from packing and insures the delivery of free material through an opening into the pockets of the fluffer wheel below, where the coal is well aerated.

From the pockets of the fluffer wheel, it drops through an opening into smaller pockets or compartments of the rotating feeder wheel below, where the pulverized coal is further aerated and each pocket is filled with a definite quantity of material of uniform density. For that reason



The Bailey pulverized coal feeder for kiln firing, installed at the plant of the Volunteer Portland Cement Co., Knoxville, Tenn.

a counter on the feeder wheel, if calibrated, accurately records the number of revolutions of the feeder wheel and shows within two per cent the actual tonnage of coal used.

After being carried around in the pockets of the feeder wheel, the pulverized coal drops into the pockets of the discharge pipe, thence into the mixing tee, where air from a fan carries it through the burner pipe into the kiln or furnace.

Construction of the fluffer and feeder wheels precludes flooding and insures a uniform, controllable feed, which are the features of this pulverized coal feeder for rotary kilns that are of interest to cement manufacturers.

In the manufacture of portland cement, many different types of feeders are used for delivering material to the various operations throughout the plant. The first feeding

mechanism may be described as the conveying system for transporting the raw materials from quarry to crusher.

Primary crushers are usually equipped with a drag or chain type of feeder which operates slowly and conveys the rock uniformly to the crusher. The same result is accomplished in dry process plants on dryers, where reciprocating and drag feeders are used to convey the crushed rock into the dryers.

Ball Mill Operation

Ball mills are usually fed by means of a table feed which can be set to deliver accurately a fixed quantity of dry material. The problem of furnishing a uniform feed to dry tube mills presents difficulties which a variety of feeders have not wholly solved, perhaps due to the nature of the granulated feed usually supplied and the existence of the same bin conditions already described with pulverized coal, causing a change in the rate of flow and necessarily a wide variation in mill output and fineness.

Poidometers are the one exception, having in recent years been installed on tube and compartment mills in many plants and giving excellent satisfaction; the range of accuracy of these feeders is within reasonable limits.

In dry process plants, the uneven feeding of the pulverized raw material from kiln storage bins into the kiln by the long-established screw feed method, is quite as serious as the irregular feeding of pulverized coal at the discharge end of the kiln. The problem is as old as the rotary kiln itself. When the supply of finely ground raw mix runs low in the large storage bin, flooding of the screw in the hopper below invariably takes place. The same bridging-over described in the coal bins occurs in the kiln supply bins, and when the arch breaks there is a great rush of material into the kiln, which, on account of its extreme fineness, has great fluidity. When flooding occurs, it interferes with the normal operation of the kiln, causes the burning of more fuel or reducing the speed of the kiln, in order to retard the operation long enough to burn the excess load properly.

Regularity of Feed

The requirements of a feeder for pulverized dry raw material are that it shall be reliable and correctly designed for the work it has to do. The wearing parts must be made of metal which will resist abrasion and withstand the service required; but above all, it must give close regulation of the feed. In view of the successful application of the Bailey feeder to pulverized coal, and the dire need of a uniform, controllable supply of raw materials in dry process rotary kilns, it would seem advisable to try out this same type of feeder for that purpose. This feeder has solved one variable feeding condition with which all cement manufacturers using coal in their kilns have to contend. If variations in the feeding of dry raw mix can be eliminated by the same device, then will the kiln operator have positive control over combustion conditions, and he can produce the maximum output of uniformly burned clinker with the minimum consumption of fuel.

An important point in connection with the use of the type of feeders here described is the necessity of removing all tramp iron and other foreign matters from the pulverized material handled, on account of the close clearances of the working parts of the feeder.

It is common practice to screen cement before it is packed, to remove any coarse particles of clinker or foreign material, in order to improve the operation of the packing machines.

Similar screening equipment, supplemented by magnetic separators, would insure the continuous performance of Bailey feeders on either pulverized coal or raw material.

EDITORIAL

Getting the Tariff Bill Out of the Way

ONE of the most urgent necessities at this moment, in so far as the cement industry is affected, is to get the tariff bill out of the way.

The cement industry is affected directly, for the new bill will determine whether this basic material is to continue on the duty-free list, or whether a small measure of protection against foreign competition is to be provided.

Aside from the direct interest of their own industry, cement manufacturers are vitally interested in having the uncertainties of tariff revision removed from the business and industrial picture. Many industries are to be affected by the new tariff law, some favorably and some adversely. The uncertainty of the situation is without question causing many business and industrial organizations to postpone extensions which, when made, will mean new buildings and the installation of new equipment.

Appeals for action addressed to your personal acquaintances in Congress, more especially in the Senate, will help to remove this disturbing element from the list of uncertainties now confronting business.



More Definite Knowledge About Grinding

THE cement manufacturing industry is in urgent need of more definite information on the grinding of raw material and clinkers. In the grinding of raw materials, investigation and study are needed to determine more definitely the relationship between size distribution in kiln feeds and chemical combination during burning. In the case of clinker grinding, investigations are needed to establish more definitely the relation between the size distribution in the finished cement and its strength.

In general, it appears that there are two effective ways of obtaining satisfactory early strength in portland cement. One method, and this is the one too frequently employed, is to grind the clinker excessively and to carry a gypsum content to the limit permitted by specifications. This method is objectionable because when the normal clinker is ground excessively the resulting product is likely to deteriorate rapidly during storage, becoming lumpy and weakened from hydration, and there is further danger because the large quantity of extremely fine sizes resulting from excessive grinding creates conditions tending toward flash set, even with a high SO_3 content. This method is also expensive, due to the excessive power requirements.

The second and more desirable method to attain

the quality of high early strength in portland cement is to produce a clinker of complete chemical combination with a high lime content. When the raw material grinding is such that a high lime content can be carried without excessive fuel requirements and a complete chemical combination is attained, the resulting clinker has a low grinding resistance and higher strength. It can, therefore, be so ground that no objectionable particles are present, and without objectionable proportions of ultra-fine sizes. With such a clinker grinding can be accomplished at a high production rate and low power requirements.

Since it is evident that the proper size-distribution in kiln feeds is of outstanding importance, there is urgent need for an exchange of ideas within the industry. A vast amount of information has been obtained as a result of plant experiences wherever grinding investigations have been conducted.

The publication of such investigations, no matter how fragmentary the individual attainments may be, will lead to greatly improved knowledge of this important subject. We invite the industry to make use of our pages in the exchange of experiences, and not only those dealing with grinding, but those having reference to any other production problems. We believe this to be the most effective means of advancing the art of cement manufacture.



Specification for High Early Strength Cement

THE American Society for Testing Materials vote by letter ballot, on the question of adopting a specification for high early strength portland cement, has resulted in favor of this important move. The specification has now been passed on to the newly created Committee E-10 for consideration, and if such consideration is favorable the specification will be advanced to the status of a tentative standard.

The proposed specification in its present form establishes a minimum sulphuric anhydride (SO_3) content of 2.50 per cent, as compared with a maximum of 2.00 per cent for portland cement. There is no other difference in the chemical content of the two.

The tensile strength requirements of the standard 1:3 mortar for high early strength portland cement is 275 lb. per sq. in. in 24 hours and 375 lb. in 72 hours. The 28-day strength must be at least equal to the strength at 72 hours.

The adoption of this specification may be depended upon to clear the atmosphere, for there will be a definite line of demarcation between the two cements, which are to be known technically as portland cement and high early strength portland cement.

Northwestern States Files Rate Complaint

The Northwestern States Portland Cement Company, Mason City, Iowa, has filed with the board of railroad commissioners for Iowa, a complaint in which the freight rates on coal from mines in Iowa to Mason City is attacked as unreasonably high and discriminatory.

The complaint attacks the joint line as well as single line rates. The inequalities of the joint line rates are particularly stressed because, it states, in many cases, joint line movements are necessary in reaching Mason City, while competing points have the benefit of single line rates that are lower than the maximum rates prescribed by the Iowa railroad commission.

Coal rates in Iowa underwent a revision in 1922 at which time the present scales of distance rates were made effective.

January 28th was set for the hearing.

Stockholder Seeks to Prevent Universal-Atlas Merger

A petition has been filed in Philadelphia by a stockholder of the Atlas Portland Cement Company asking for a temporary injunction to restrain the directors of Atlas from conveying the assets of the company to the United States Steel Corporation. The petition is said to be preliminary to a request for a permanent injunction.

Officials of the merged Universal Atlas Portland Cement Co. state that the suit has given them no cause for worry, for the reason that more than 90 per cent of the 900,000 shares of Atlas stock was represented in the vote in favor of the merger and that no votes were cast against the merger.

Canada Cement Earnings Show Increase

Canada Cement Co., Ltd., reports for the year ended November 30th, 1929, a net income of \$1,600,701, after depreciation, interest and reserves, equivalent, after 6½ per cent preferred dividend requirements, to 38 cents a share on 600,000 no-par shares of common stock.

This compares with \$1,396,951, or 5 cents a share on common, in the previous fiscal year.

Cement—A Chemical Manufacture—and the Chemist's Part

Only of late years can the claim be justified that the portland cement industry has raised itself to the status of a chemical manufacture. It is true there is no recognized definition of a chemical manufacture, but the technical literature of cement and a knowledge of modern cement works make it impossible to dispute the inclusion of portland cement in that category. No longer can it be said that cement is made by calcining and grinding a mixture of raw materials containing about 76 per cent of carbonate of lime, states an article in a recent issue of *Cement and Cement Manufacture*. The cement made in such a way could not maintain a position in the forefront of the modern market that is so keenly competitive in regard to quality. The constituents of cement that were formerly thought to be of minor importance have now to receive attention, and, where necessary, silica, alumina or iron oxide must be imported in the same way that gypsum has been brought to cement factories. The degree of contamination with coal ash must also be taken into account, and

adjustments made to the raw material mixture to compensate for variations in the percentage and composition of the ash in the coal. The stage is imminent when cement will be judged by the proportions of the silicates and aluminates of lime it contains, although at the outset such proportions will be calculated and not revealed by direct determination.

These changes imply that in a cement factory which aims at remaining in the forefront in the race for quality supremacy the chemist's part is becoming of great importance, and with the development of the chemist there will follow a tendency to greater accuracy. Irregularities and inaccuracies are as abhorrent to the chemist in the factory as in the laboratory; even more so, because the chemist realizes more than anyone else that the efficiency of the crucial process in cement manufacture, viz. calcination, is severely handicapped because of its restriction to "clinker-ing" and its inability to pass on to fusion. The stage of fluidity which would be of immense advantage in producing the perfect amalgamation and consistency that lead to maximum yield of the desired chemical compounds is not reached in the kiln, and it is therefore necessary that the interaction of particles of lime and argillaceous matter should be facilitated by fine grinding and intimate mixing. To attempt to make a cement containing definite proportions of the known silicates and aluminates of lime from slurry having a residue on a 50-mesh sieve seems as unreasonable to chemists as using tap-water for chemical analysis. Similarly, if 77 per cent of carbonate of lime is needed in a raw material mixture to produce the required cementitious compounds, it is folly to permit a mixture containing 77.2 per cent carbonate of lime to be used, especially when air-agitation of slurry can be applied to effect consistency of composition. The ideals of the chemists are accuracy and consistency, and the means of obtaining these are mixing at every stage of the manufacture—not only slurry mixing, but clinker mixing, cement mixing, and even coal mixing. In due time, the physicist will be needed to investigate the problems connected with the degree of calcination and the size of particle in the finished cement.

Figures on Yugoslavian Cement Industry in 1928

According to statistics gathered by the Chamber of Commerce and Industry of Zagreb the production of the cement mills in operation in Yugoslavia amounted to 808,442 tons in 1928, as compared with a production of 726,875 tons in 1927. Compared with the output of 1922 the production has doubled.

Exportation of cement has increased in the same degree as production. In 1928 Yugoslavia exported 374,451 tons of cement, as compared with 317,427 tons in 1927. The volume of cement exportation represents 8 per cent of the total exports of the country.

At the present time there are 14 cement plants in Yugoslavia, of which 11 are in active operation; two mills are being reorganized and one, at Bakar, is being abandoned.

The mills of the Dalmatian valley assure almost entirely the total of the cement exported; those of the interior working almost exclusively for local markets.

Ohio Cement Production

Portland cement production in Ohio is valued at \$23,300,000 or 3 per cent of the total of all mineral industries in the state, according to H. E. Nold, professor of mine engineering, Ohio State University.

Effect of Fineness and Composition on Quantity of Water in Cement

Variations in Concrete Strength of Mixes of "Wet" Consistency Using Cements of Equal Standard Test Strength Accredited to Fineness of Cement — View that Cement Develops Best Properties As It Is Ground Finer Held in Error

By PROF. HANS KUHL

STANDARD cement tests deal with definitely specified quantities of water. The experience with standard tests teaches us that even slight variations in the quantity of water used result in variations of the strength values. Although this has been known for some time and is substantiated by observations on a large number of cements, the numerical relations, according to which the strength values vary with the water content, have not been established. The discrepancies, observed with different cements, apparently follow no definite law; they show a uniformity only in one respect, namely, that when the water content is increased beyond a certain "correct" value a decrease in strength is sure to follow; the extent of this strength decrease, however, differs greatly with different cements. Even more pronounced is the effect of water content on strength in concrete. The following example is taken from an article by Dr. Guttman in No. 22 of "Tonindustrie-Zeitung," 1928. Two portland cements G and St had practically the same test strength, namely, 434 and 443 kg. These cements were mixed under identical conditions with Rhine sand and Rhine coarse aggregate in a proportion of 1:3:3 to a concrete of "wet" consistency with 13 per cent mixing water. Concrete tests at 28 days yielded in one case 160 kg., in the other only 80 kg. Dr. Guttman concludes not without reason that the effect of quantity of mixing water is a very important problem, without, however, searching for the cause of this most extraordinary phenomenon that one of two cements having the same test strength and mixed under identical conditions yielded only half of the concrete strength of the other.

Cement and Concrete Strengths

We deal here with an observation of utmost importance for the practical man. Your association has always emphatically held that the testing of hydraulic materials should be an individual one, that the specifications for one such material should be different from those of others. For example, the standard specifications of portland or slag cement should not be directly made to apply to tests of other materials. The value of this view is best demonstrated by the example in question. If two portland cements of equal test strength can yield a concrete strength differing by 100 per cent, how great would be the differences in concrete strength—which after all is the more

important one from the practical standpoint—of two entirely unlike cements with equal test strength?

There is another side to this problem: Guttman's observation shows us how very dangerous it is to compute a probable strength value from a given strength value even for similar materials, or even for portland cements only—which are of particular interest to the association. Going out from compiled statistical material, it has been often attempted to establish formulas for such computations of strength values; I need only remind you of Feret's suggestions. With the aid of such formulas one may with some approximation conclude as to what some one value of standard mortar strength would be when given another; yet it is quite impossible to go from standard strength to concrete strength of mixes of plastic or sloppy consistency. Statistical data permit us to establish certain general relations which apply to averages. The application of such general rules to individual cases, however, always remains an act of daring, as long as we don't know which factors control the effect of the water-cement ratio for a given brand of cement. It is, therefore, a welcome sign to see that cement users are also coming to realize the value of concrete tests beside the standard cement tests.

Composition Cause of Difference

Getting back to the point, i. e., to Guttman's observation that two portland cements of equal test strength differ by 100 per cent when mixed to concrete of "wet" consistency. It is the author's conviction that these cements must have had some peculiar property from the moment they left the plant, which produced equal values in standard mortar tests and a great difference in concrete strength. It seems reasonable to assume that this difference may be due to different fineness or to different chemical composition. Accordingly the author planned a series of tests with cements of widely different composition and very different fineness and studied the effect of the water-cement ratio on strength on specimens made with such cements.

Four portland cement clinkers were used in this investigation—one shaft kiln product and three products of rotary kilns; their composition is given in Table 1. It is plainly seen that these four cements represent as wide a range of variation as it is possible to assume; their hydraulic modulus ranges from 1.97 to 2.38; the silica modulus from 1.30 to 2.63 and the iron oxide modulus from 1.09 to 1.89. If the chemical composition has any

Paper read in Dresden, September 2, 1929, at the meeting of the Association of German Portland Cement Manufacturers, and translated from *Zement*.

TABLE 1

Analyses

	Cement A	Cement B	Cement C	Cement D
Clinker				
Loss on ignition	0.64	0.43	0.35	0.42
Silica	19.53	22.97	19.76	18.69
Alumina	4.68	5.72	7.73	8.49
Iron oxide	4.29	3.03	5.42	5.93
Lime	67.90	65.27	64.95	65.21
Magnesia	2.13	2.08	1.28	1.12
Sulphuric oxide	0.57	0.42	0.38	0.20
Hydraulic modulus	2.38	2.06	1.97	1.97
Silica modulus	2.18	2.63	1.50	1.30
Iron oxide modulus	1.09	1.89	1.43	1.43

influence at all on the effect of the water-cement ratio, it should become evident in an investigation of cements of such widely differing composition.

To follow further the effect of grading six cements were ground to varying fineness from the four original clinkers, the series thus including 24 cements. The clinker was ground in a laboratory ball mill in quantities of 20 kg. and with a constant charge. The coarsest sample was ground for $2\frac{1}{3}$ hr., the finest for 14 hours; the other cements were ground for $3\frac{1}{3}$, 5, 7 and 10 hr.

The 24 cements, obtained from the four clinkers, were mixed to a "moist," plastic and "wet" consistency with standard sand, the total number of tests thus becoming 72, and were tested in tension and compression at the age of 3 days, 7 days and 28 days, each value representing the average of 5 specimens. The specimens were cured in water and in air and water as prescribed by the German standards.

In using standard sand in all tests, the author was conscious of the fact, that the use of a "wet" consistency with standard sand is contrary to standard procedure; this consistency requires the use of graded aggregate. Nevertheless, it was used to make the effect of the quantity of mixing water more apparent. The author was not trying to work out a testing procedure for mortar of "wet" consistency, but strove to demonstrate the strength reducing property of the higher quantities of mixing water, which was easier to accomplish with standard sand than with a graded aggregate.

The making of the specimens of "moist" consistency followed the standard procedure. Accordingly the quantity of mixing water required was determined for each cement and the cement mixed with this quantity of water. The plastic mortar was obtained by increasing the quantity of mixing water of the "moist" consistency specimens by 40 per cent; the same quantity was increased by 70 per cent for the "wet" consistency specimens. For example: if the quantity of mixing water of the standard specimens amounted to 7 per cent, that of the plastic mortar was 11.2 per cent and that of the "wet" 13.6 per cent.

Making of Specimens

While the "moist" specimens were placed into the mold by means of the hammer apparatus, the plastic and the "wet" were worked by hand, i. e., tamped into the mold by means of a small hand tamper. It is natural that the accuracy of the "moist" consistency specimens is considerably higher than that of the plastic or "wet" specimens. Yet the difference observed in the three groups of strength tests is so clear, that the slightly greater adjustment of the single values in the "plastic" and "wet" groups could not have been of much influence on the final result.

In coming to the results of tests, the author wishes to

point out the different behavior of the cements in the ball mill. Though the cements were of a widely varying composition, and were not all products of the rotary kiln, but included that of a shaft kiln, the general trend of the grinding process was much the same. Table 2 shows that the amount retained on the 4900 mesh-sieve (4900 m. per sq. cm.) after $2\frac{1}{3}$ hr. was almost the same for all clinkers, these amounts ranging from 22.5 per cent to 26 per cent. Differences appeared with additional grinding, yet seemed to follow no definite rule. Thus, for example, the cement having a maximum amount retained after the first grinding period became the finest after 5 hours and remained finest to the end.

TABLE 2

Amounts Retained on Sieve and Quantity of Water

Hours of Grinding	$2\frac{1}{3}$	$3\frac{1}{3}$	5	7	10	14
Amount retained on 4900-mesh sieve						
Cement A	22.5	18.0	15.0	10.4	7.1	4.5
Cement B	26.0	14.5	8.4	5.4	3.0	1.5
Cement C	25.3	17.6	14.4	10.1	7.4	4.5
Cement D	23.2	12.1	9.0	6.6	4.1	3.0
Water required for normal consistency in per cent						
Cement A	23 $\frac{1}{4}$	23 $\frac{3}{4}$	24 $\frac{1}{4}$	25	26 $\frac{1}{4}$	27 $\frac{1}{4}$
Cement B	22 $\frac{1}{2}$	22 $\frac{3}{4}$	23	23 $\frac{1}{2}$	24	(>30)
Cement C	22 $\frac{1}{4}$	22 $\frac{3}{4}$	23 $\frac{1}{4}$	24	25	26
Cement D	24	24 $\frac{1}{4}$	24 $\frac{3}{4}$	25 $\frac{1}{4}$	25 $\frac{3}{4}$	26 $\frac{1}{4}$

This was cement B with exceptionally high silica content. Notable is that of the four clinkers, the shaft kiln clinker, i. e., cement A, shows the highest residues almost in every stage. It shows that the old belief that a shaft kiln clinker is easier ground than the rotary kiln clinker does not apply in every case and that a laboratory ball mill may yield the opposite results. I have often found that a shaft kiln clinker is harder to grind in a laboratory ball mill than the product of the rotary kiln; I believe that the cause of this lies in that the rotary kiln clinker, though harder, is more brittle than the clinker of the shaft kiln; brittleness seems to become particularly apparent in a laboratory mill.

All cements were slow-setting in the coarser groups. Only when the time of grinding is prolonged to 10 hours is the time of set reduced considerably with two cements. Three out of the four cements remained slow-setting even after 14 hr. grinding; the fourth cement changed to an immediately-setting cement after 14 hr. grinding; it is noteworthy that this was the same cement which after 10 hr. still appeared to be slow-setting; apparently a sudden jump took place in the time of set with further grinding. This has been observed by the author on a previous occasion. In 1917 the author published in "Tonindustrie-Zeitung" a report of fineness tests, in which he established that a cement which with a 15.4 per cent residue still showed a time of set of $3\frac{1}{2}$ hr., showed a time of set shorter by 7 minutes when ground to a 10.5 per cent residue.

This remarkable phenomenon, that cement undergoes a sudden change in time of set when a certain fineness is exceeded, gives me the opportunity to point to an investigation suggested by me and carried out by Dr. Brans. Dr. Brans produced gypsum of greatly varying fineness and studied the effect of coarse and fine gypsum admixtures on the time of set of portland cement. It was at first apparent that the finely ground gypsum had a more marked effect than the coarser gypsum, which needs no explanation. Of utmost interest, however, is Dr. Brans'

discovery that each gypsum fineness has a definite limit, below which that fineness appears to have no appreciable influence on the time of set. Tables 3 and 4 were compiled by the author from Dr. Brans' data.

TABLE 3
Effect of Gypsum on the Initial Set

Gypsum Fineness	Very Coarse		Coarse		Medium Fine		Fine	
Admixture of gypsum %	21.5	25.8	17.2	19.4	10.8	11.3	2.7	3.8
Initial Set	5m.	400m.	6m.	300m.	4m.	210m.	5m.	118m.

TABLE 4
Effect of Gypsum on Final Set

Gypsum Fineness	Coarse	Medium Fine	Fine	Very Fine				
Admixture of gypsum %	12.9	14.0	10.2	10.8	4.8	5.3	1.6	2.2
Time of set	20m.	135m.	25m.	210m.	15m.	138m.	25m.	190m.

First you see what large quantities of gypsum must be used, when gypsum is coarse, to retard the set of a quick-setting cement: the values increase up to 25.8 per cent gypsum for the coarsest group. More interesting, however, is the jump, which is particularly apparent in the initial set, after the limit value is exceeded. While with the coarsest gypsum an admixture of 21.5 per cent shows hardly any effect on the initial set, this initial set rises to 400 min. or almost 7 hr. when the gypsum admixture is raised to 25.8 per cent. Similar are the conditions in the finer gypsum groups, although the absolute quantities of gypsum are naturally lower here. Although not quite as clear as in the initial set, the effect of gypsum on the final set is quite apparent and definite limit values can be easily recognized here.

I will not take the time to discuss here the theoretical reasons for the jump in the effect of gypsum admixtures, and will refer the interested to my paper "Hydraulic Hardening as Colloid Chemical Problem," read at your general meeting in 1922. It will suffice here to point out this most interesting parallel between the jump in the effect on time of set of fineness and the similar phenomenon of the gypsum admixtures. Evidently the causes of the two relations deal with a surface effect, which brings about the sudden jump in time of set.

Returning to the subject of fineness of cements, it is

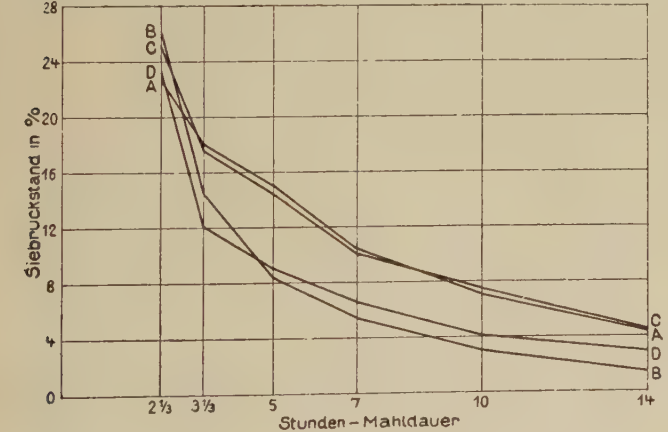


Fig. 1. Curves of time of grinding

now to be compared to the quantity of water required by the 24 cements to produce normal consistency. I wish to show you again Table 2 and to draw your attention to the fact that all 4 cements show an increase in the quantity of water required with increasing fineness, although no strictly parallel relation can be observed in this connec-

tion. These relations are even better demonstrated on a graph, as in Figs. 1 and 2. Please note the curves of the fineness diagram as well as those of quantity of mixing water required show two distinct groups among these cements.

The curves of sieve residues show a similar trend of curves A and C and of curves B and D. Just why these

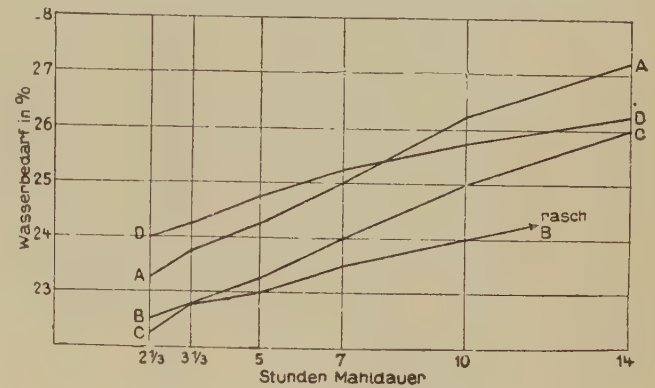


Fig. 2. Curves of mixing water required

cements could be grouped in this manner according to fineness is not clear to the author; their chemical composition would warrant a different grouping, cements C and D and cements A and B being chemically speaking closer to each other.

Notable is that the similarity according to fineness is repeated in a similarity with respect to water required. Fig. 2 shows that two curves of the quantity of mixing water required rise with a considerable slope. These are the curves of cements A and C, while the two other curves are relatively flat and very similar in outline; these are the curves of cements B and D. We, therefore, find that the cements C and A which are harder to grind have a relatively higher water requirement with increasing fineness, than cements B and D which are easier to grind and whose mixing water curves remain relatively flat. This fact permits us to recognize clearly a relation between fineness and quantity of water required. This relation appears to be a parallel between the fineness reached and

TABLE 5
Standard Properties of Cements for Most Favorable Fineness

Cement	A	B	C	D
Hydraulic modulus	2.38	2.06	1.97	1.97
Time of grinding	7 hr.	7 hr.	10 hr.	10 hr.
Residue on 4900-mesh				
sieve	10.4%	5.4%	7.4%	4.1%
Standard test	O.K.	O.K.	O.K.	O.K.
Boiling test	Cracks	O.K.	O.K.	O.K.
Normal consistency	25%	23½%	25%	25¾%
Initial Set	1¾ hr.	1½ hr.	1 hr.	½ hr.
Final Set	4 hr.	4½ hr.	3¾ hr.	2¼ hr.
Tensile Strength 1:3				
3 days water	17.4	29.4	31.5	26.6
7 days water	17.4	30.4	33.8	25.4
28 days water	23.4	32.1	35.6	31.0
28 days combined*	33.8	42.0	41.4	35.4
Compressive Strength 1:3				
3 days water	293	295	364	260
7 days water	338	369	424	301
28 days water	358	429	548	405
28 days combined	402	503	614	520
Evaluation	2311	2935	3373	2670

*Note by translator: German standards call for 1 day in moist air, 6 days in water, remainder in air curing.

the quantity of mixing water required. This is a practical truth which agrees with theory, although the author will not go into this any further at this time.

The strength data acquired in testing the 72 mixes at 4 different ages are so extensive that they cannot be reproduced here. I will limit myself to emphasizing the most important points. Table 5 gives the results of standard tests of the best cement from among the four clinkers. It will be observed that clinkers A and B were ground 7 hr., clinkers C and D 10 hr. to obtain the best results. Concerning their strength, it is shown that the compressive strength at 3 days of all four cements proves them to be high test cements. With respect to tensile strength, cement A shows a lag; this is no doubt due to the fact that this cement does not pass the boiling test. I will not consider here the individual results, but will draw your attention to the last line of the table labeled "evaluation." This value is obtained by multiplying each tensile strength by 10 and subsequently adding all tensile and compressive strength values. Thus the first "evaluation" 2311 is obtained by adding the 8 values above it. This procedure is repeated for the other cements.

Working with such evaluations has its flaws, for a value of this kind does not note the special properties of a cement. Thus a cement with very high compressive strength and relatively poor tensile strength may have a better evaluation value than one whose compressive and tensile strengths are equally good, yet not very high. This value can also be misleading when some specially high value increases it out of proportion, as for example, a very high tensile strength for combined curing. In spite of such imperfections, this evaluation, as used here and in some of my previous work, is a good means of reviewing an extensive collection of data. Upon arranging the cements according to their evaluation, one proceeds without difficulty to look up some of their peculiar properties.

This evaluation is particularly adapted to the present problem, as becomes evident in looking over Table 6 containing evaluations of all 76 tests. The table shows four distinct groups which contain the results of the four clinkers. Each group has six columns, which represent the time of grinding ranging from 2 1/3 to 14 hr. The evaluation of test results is also given for three consistencies—

TABLE 6
Evaluations

Grinding	2 1/3 hr.	3 1/3 hr.	5 hr.	7 hr.	10 hr.	14 hr.
Cement A						
Moist	2038	2156	2258	2311	2209	1987
Plastic	1279	1372	1563	1302	1136	1105
Wet	1142	1303	1282	1115	974	846
Cement B						
Moist	2559	2567	2743	2935	2574	(2200)
Plastic	1525	1682	1976	1768	1595	(1400)
Wet	1410	1601	1763	1701	1410	(1200)
Cement C						
Moist	2767	2973	3112	3293	3373	3331
Plastic	1603	1678	1704	2065	2013	1915
Wet	1234	1340	1652	1768	1725	1703
Cement D						
Moist	2347	2506	2620	2652	2670	2142
Plastic	1823	1837	1924	2020	1580	1154
Wet	1308	1468	1735	1607	1359	1017

moist, plastic and wet—for each cement. It remains to add that the values for cement B in the last column were not obtained directly, but extrapolated. This was neces-

sary because, as you will remember, cement B in its finest stage became so quick-setting that it was no longer possible to carry out actual strength tests.

In looking over the evaluation, one notes that the finest cement is in no case the one having the highest evaluation. The highest evaluations do not lie among the finest, but among the medium grindings. Thus for the "moist" consistency group they are between 7 and 10 hr. grinding. Further grinding reduces the evaluation of cements to a not inconsiderable extent; thus the evaluation of cement A falls from 2311 to 1987 and of cement D from 2670 to 2142.

The table shows that an increasing quantity of mixing water reduces the strength values, which is very pronounced in the transition from "moist" to plastic consistency and relatively less marked in that from plastic to "wet" consistency. Particularly noteworthy is that an increasing water-cement ratio results not only in lower strength, but that a displacement takes place in the *quality sequence* of cements, the *maximum strength values becoming displaced toward coarser grinding*. This is the more remarkable as without knowledge of the present data one would naturally suppose that a wet mix would benefit by greater fineness of cement. These tests, however, show the

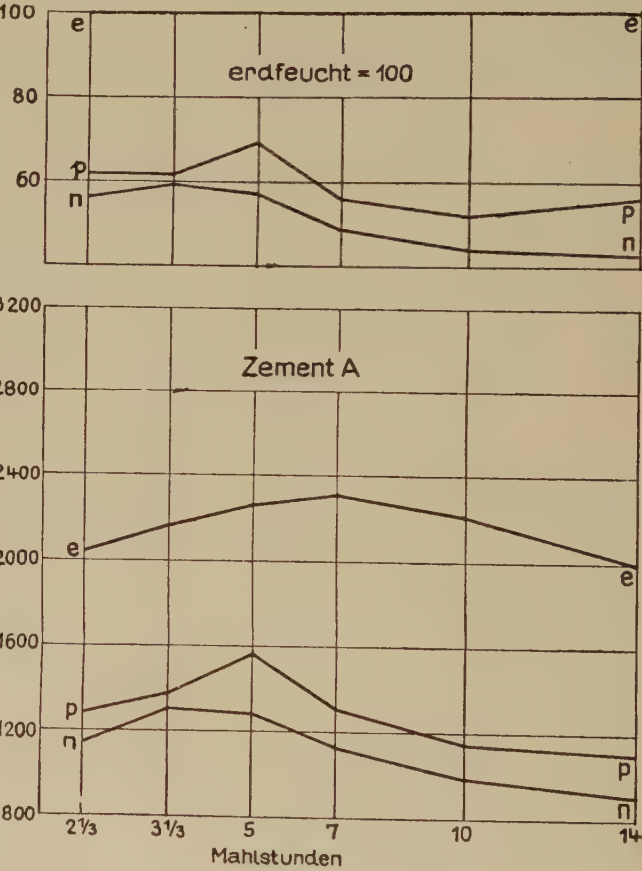


Fig. 3. Strength curves of Cement A

opposite to be true so conclusively that there can be no doubt as to the accuracy of this statement. To emphasize this the maximum value in each column of the table is underlined and one can see how for cement A the maximum moves with additional water from 7 hr. grinding to 5 hr. grinding and with further addition of water to 3 1/3 hr. grinding. The same change takes place for cement D. It is less apparent for cements B and C, for the maximum here is found for the same fineness with plastic and wet consistency, though this fineness is coarser than that of the maximum for moist consistency.

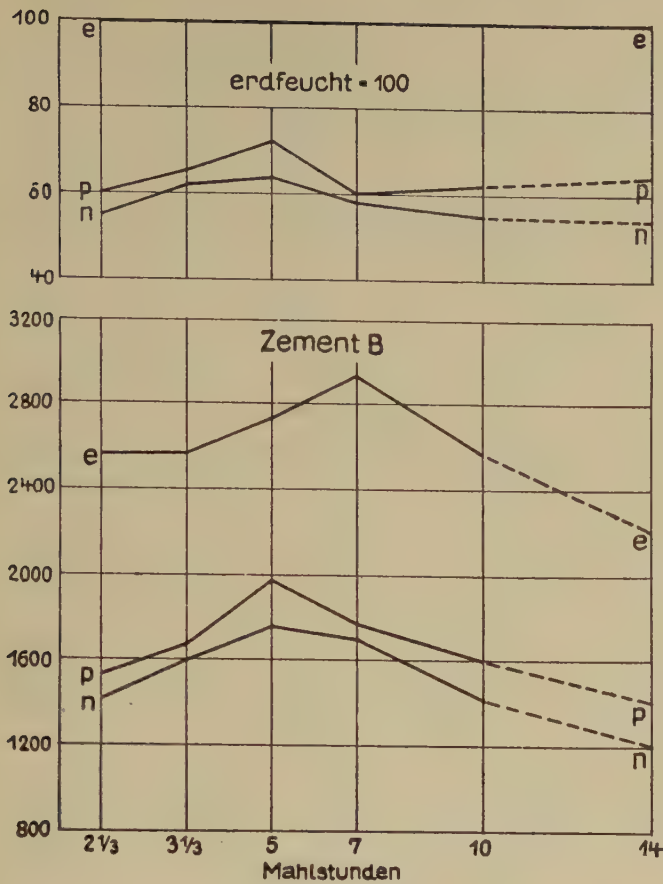


Fig. 4. Strength curves of Cement B

To make these relations even more apparent, I have recomputed all values assuming the evaluation of the “moist” consistency test to be 100. The results are compiled in Table 7. This table permits us to recognize immediately the trend of the strength maximum toward coarser grinding in going from plastic to wet consistency. Even more important is the insight which this table affords into the *extent* and *relative conditions* of the strength drop due to increasing quantity of mixing water. In the most favorable case the strength drops from 100 to 72 in the transition from moist to plastic consistency; in the least favorable from 100 to 52. In going from “moist” to “wet” consistency these drops are even more emphatic, that of the most favorable instance being from 100 to 62, while in the least favorable from 100 to 42. This means that: *With equal strength for “moist” consistency, the strength of the “wet” consistency specimens differs by more than 50 per cent.* It is to be noted that the cements undergoing the least strength drop in the transition from “moist” to “wet” consistency are those of medium fineness, while the greatest strength losses are to be found with the greatest finenesses.

These relations are shown graphically in Figs. 3 and 6. The lower part of each graph shows the absolute evaluations, while the upper represents the evaluations assuming that of moist consistency to be 100. One can see that the values of plastic and wet consistency are rather close to each other and that both are far below the curve of “moist” consistency. With increasing water content the maximum of the curves becomes displaced to the left, i. e., in the direction of coarser grinding, as is also apparent from the table.

In summarizing the results of this study, it is established that there is a relation between the trend of the fineness curves and the quantity of mixing water of cement, which gives a practical proof of the theoretical requirement that

TABLE 7						
Evaluation of “Moist” Consistency = 100						
Cement A						
Grinding	2 1/3 hr.	3 1/3 hr.	5 hr.	7 hr.	10 hr.	14 hr.
Moist	100	100	100	100	100	100
Plastic	63	63	69	56	52	56
Wet	56	60	57	49	44	42
Cement B						
Moist	100	100	100	100	100	(100)
Plastic	60	65	72	60	62	(64)
Wet	55	62	64	58	55	(54)
Cement C						
Moist	100	100	100	100	100	100
Plastic	58	57	55	63	60	58
Wet	44	45	53	54	51	51
Cement D						
Moist	100	100	100	100	100	100
Plastic	(77)	73	73	76	59	54
Wet	56	58	66	61	51	48

the water required for normal consistency of well calcined and freshly ground portland cements is independent of the chemical composition of the cements and rises approximately parallel to the fineness.

The study of strength property disclosed no effect of the chemical composition on the relation between strength and water-cement ratio. On the other hand, all test cements revealed a definite relation between strength drop with increasing water-cement ratio and fineness, the maximum strength values of all tests being found not for the finest, but for the medium fine cements. It was shown further that the drop in strength with increasing water content is less marked for coarser cements than it is for finer cements, and, finally, that the absolute value of the strength drop varied within wide limits, so that the

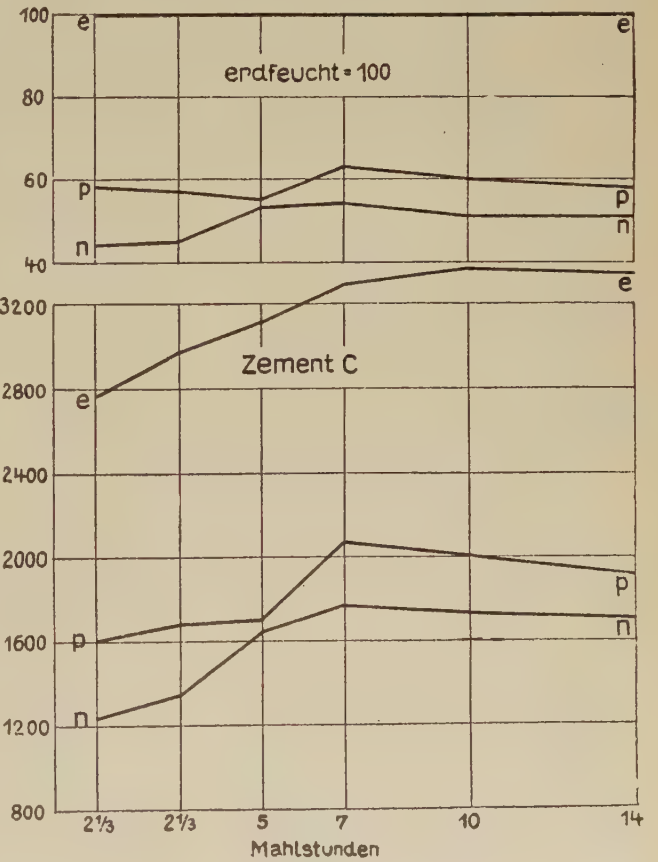


Fig. 5. Strength curves of Cement C

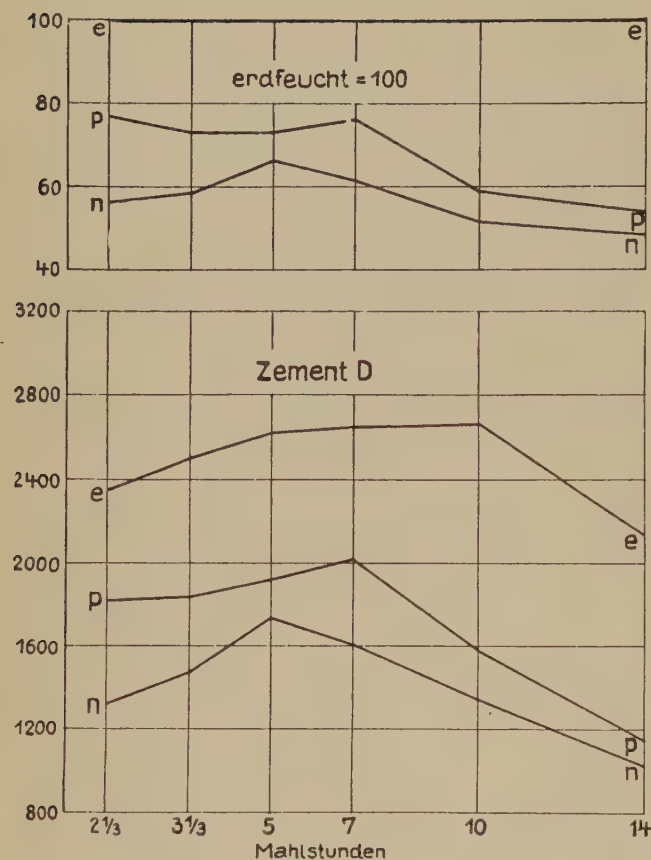


Fig. 6. Strength curves of Cement D

strength values of wet consistency with relation to those of "moist" consistency varied one from the other by more than 50 per cent. While this difference is not quite as great as that obtained by Guttman in an extreme case of concrete strength, it seems nevertheless to show a similar trend and again brings up the question which followed from Guttman's observations: why do cements with equal standard test strength differ so greatly in concrete strength of mixes of "wet" consistency? It appears from the foregoing that this question has an answer in that *these differences are due to the fineness of cement.*

As contradictory as this may seem at first glance, namely, that not the finest but the coarser cements are best adapted to the higher water contents, a closer study brings an agreement with the theory of the setting processes. If we assume with Michaelis that the finest particles of cement and water first form a gel, which gradually coagulates through "inner suction," we will see that the fine and coarse particles of cement meet entirely different tasks; the finest particles mainly work to form the gel, while the coarser particles absorb water from the loose gelatinous mass in the course of their gradual hydration and thus produce hardening of the mass.

If the same cement is mixed with different quantities of water, the quantity of reacting cement particles remains the same within a given period of time, for it depends only on the contact surfaces between cement and water, which would remain constant regardless of increasing water admixture. This results in an increasingly soft and watery gel, the higher the water admixture, and, as the number of coarse particles accomplishing the suction remains the same, this higher water admixture not only hampers the hardening process, but is the more pronounced the fewer coarser particles are present for the "inner suction" and for the work of hardening.

Therefore, it is an erroneous view that—as frequently

believed—a cement develops its best properties more and more the finer it is ground. Hauenschild remarked some years ago that the finest particles in cement are not alone instrumental in yielding the highest strength. I would like to extend this statement in saying that the most valuable cement from a technical standpoint is obtained not by the finest grinding but by a correct grinding. It appears that the inner structure of cement has a law as definite as that discovered by Fuller and Graf for the structure of concrete. It is left for further research to determine this law.

The Amazing Effect of Ready-Mixed Concrete

Ready-mixed concrete is being blamed for many of the troubles that beset the sales departments of cement manufacturing companies. A daily newspaper of state-wide circulation says:

"There has been a rather recent development in the cement industry that has interfered seriously with sales in some cities. Companies have been formed that mix cement ready for use on the job. This material is delivered ready to be poured. Contractors in many instances have discovered that this method of handling cement on the job is more economical than mixing it themselves. The sales offices representing cement manufacturers have not had the facilities to sell ready-mixed cement and as a result their sales have fallen off considerably in some cities. It is now believed this new custom for handling cement will compel many of the big corporations to fall in line with cement mixing plants established in all principal cities."

1929 Marks Sharp Reduction in Lehigh Earnings

The preliminary statement of the Lehigh Portland Cement Company, Allentown, Pa., for the year ended November 29, 1929, shows a net profit of \$2,737,476 after depreciation, federal taxes, etc., equivalent after dividends on 7 per cent preferred stock, to \$2.77 a share on 450,348 shares of common stock. This compares with \$4,124,390, or \$5.75 a common share in the preceding year.

During the fiscal year ended November 30, 1929, Lehigh Portland Cement Co. acquired 5,776 shares of its preferred stock, bringing the number thus far acquired for retirement to 13,983. Total number required to be retired as of November 30, 1929, under the provision of the issue, was 7,319. The company, therefore, has set up a credit equivalent to two years' sinking fund requirements.

In the same report President E. M. Young said also: "The installation of such equipment as was necessary to double the capacity of our newly built mill at Sandt's Eddy (Pa.) has been completed and this plant will shortly be put on a production basis of 2,000,000 barrels per year. Other minor improvements in equipment and machinery have been made at a number of plant locations."

Hawkeye to Add Crusher to Quarry Equipment

The Hawkeye Portland Cement Company made announcement recently that it will add a large crusher to its quarry equipment near Winterset, Iowa. The unit will have a capacity of 2,000 tons per ten hour shift.

The installation of the crusher will give the quarry a projected output of three hundred seventy-five thousand tons of cement raw material, in 1930.

MEN and MILLS

Notes from the Field

Dewey Employees Hold Annual Party; Firm Distributes \$12,000 in Bonuses

Employees connected for at least a year with the Dewey Portland Cement Company plant at Linwood, near Davenport, Iowa, held their annual party at the Buffalo Community hall on the evening of Saturday, January 4th. More than 300 employees and their wives attended the program and the dinner.

Later the hall was cleared for dancing and 200 more employees of the company joined the group for the remainder of the evening.

Bonus checks, ranging from 3 to 7 per cent of the annual pay of each person and totaling nearly \$12,000 were distributed, marking the tenth annual dividend of this nature paid by the company. Some of the employees, who had been at other company plants before the opening of the Linwood mill, have records of from 9 to 15 years with the Dewey company.

Wolverine Company Buys Former Bank Building for Offices

The Wolverine Portland Cement Company, Coldwater, Mich., has purchased the former national bank building there and will utilize it for office purposes, after remodeling.

For the last ten years the company has been maintaining downtown offices in the White Block. Prior to that time, the offices were located in the rear of the building just acquired by the company.

Atlas Holds Annual Safety Banquet at Hannibal

The annual banquet of the safety department of the Atlas Portland Cement Company plant at Hannibal, Mo., was held on December 17th, at a local church. The pastor of the latter was the speaker, on the subject "The Workman's Responsibility to His Family."

Newaygo Gives Employees Bonus of 8 Per Cent of Wages; Continues Group Insurance

Employees of the Newaygo Portland Cement Company, Newaygo, Michigan, at the close of 1929 received bonus checks based

on a rate of 8 per cent of their total earnings for the year.

The bonus system was inaugurated by the company several years ago and provides that each employee shall receive a bonus on his year's wages based on the same rate as is paid in dividends on the common stock of the company. The rate varies from year to year, having been as low as six and as high as ten per cent, averaging about eight. The company also maintains an insurance plan for employees.

Trophies Awarded at Nazareth Safety Gathering

At a mass meeting attended by one thousand people, the Nazareth Division of the Lehigh Valley Council presented trophies to the winners of a "no time lost, no accident" campaign. H. L. Reichenback, superintendent of the Nazareth Cement Company, presided.

Morris Fortuin, general manager of the Pennsylvania-Dixie Cement Company, awarded trophies to Marvin Parsons, for the Hercules Cement Corporation; Lawrence Rice, for the Nazareth Portland Cement Company, and Frank Leh, for the Lone Star Cement Company, Pennsylvania. R. B. Fortuin, vice-chairman of the cement section of the National Safety Council, delivered an address.

Northwestern Divides \$30,000 Bonus Among Employees

The Northwestern States Portland Cement Company distributed \$30,000 in the form of a Christmas bonus to its employees in December.

A total of 380 employees received the bonus checks, which varied in size with the length of service each one had with the company.

Northwestern Takes Part in Local Industries Exhibit

The Northwestern States Portland Cement Company, Mason City, Iowa, displayed an array of pictures of structures made of Northwestern cement in the leading local bank during December. These included the Foshay tower, the Minnesota stadium, sections of the Jefferson highway, and other projects. Miniature sacks of cement were also shown.

The exhibit was one of a series displayed weekly featuring Mason City industries.

Rally Celebrates Thirteenth Month Minus Accident at Louisiana Lone Star Plant

The thirteenth consecutive month in which no accident occurred was celebrated by the Lone Star Cement Company, Louisiana, at New Orleans with a midday rally, on December 30th. Industrial leaders, members of the executive board of the New Orleans safety council, and city officials attended. The acting mayor of the city was the chief speaker.

There has been an average of 170 men employed daily and not one has been incapacitated.

Scott Thompson, vice-president and general manager of the plant, is chairman of the industrial division of the New Orleans safety council.

Under his direction representatives, executives, superintendents, and foremen numbering more than 300 have been organized into the Foremen's Club of New Orleans. The club concerns itself with disseminating practical safety information among workers of the city.

Baylor Succeeds Sackett as Louisville Cement Company Vice-President

H. D. Baylor, plant superintendent of the Louisville Cement Company, has succeeded Frederic M. Sackett, newly named ambassador to Germany, as vice-president of the company.

Mr. Sackett resigned the vice-presidency when it was made known that he would leave immediately for Germany. Mr. Baylor has been with the company for twenty years.

The Louisville company recently amended its articles of incorporation fixing the number of directors at not less than five or more than seven.

Folse Named Secretary-Treasurer of National Portland

L. J. Folse has been named secretary-treasurer of the National Portland Cement Company of Mississippi, located at Vicksburg. Mr. Folse was since 1922 manager of the Mississippi State Board of Development, is a director in the Mississippi Valley Association and chairman of the Mississippi division of the Southern States Reclamation Association.

Cement Statistics for December

Production and Shipments for Month and Year Show Decreases—Stocks on Hand Higher

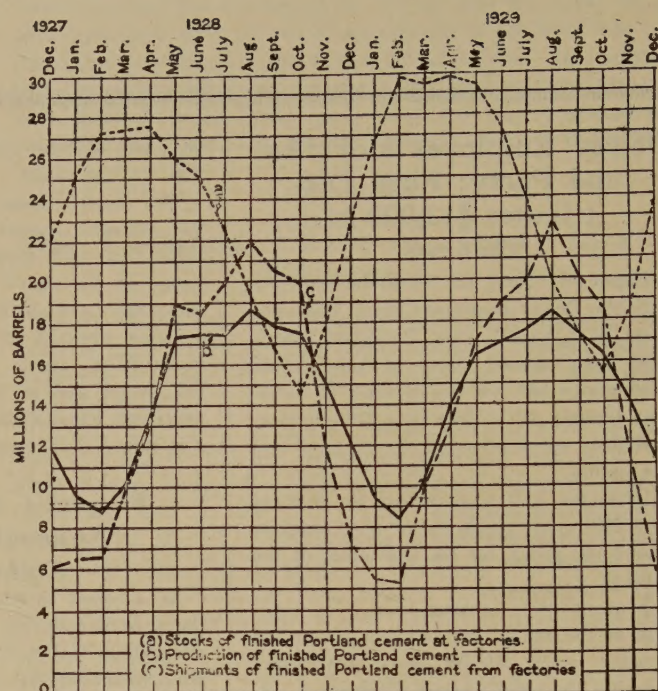
Relation of Production to Capacity

(Figures represent per cent)

	—December—		Nov.	Oct.	Sept.
	1928	1929	1929	1929	1929
The month	60.4	51.5	66.6	77.0	81.8
The 12 months ended..	74.0	66.4	66.8	67.3	67.5

NOTE: IN ORDER THAT THE READER MAY KNOW THE TREND AT A GLANCE, THE HIGHER FIGURE, WHETHER FOR EITHER YEAR, UNDER ANY CLASSIFICATION, APPEARS IN SLIGHTLY HEAVIER TYPE.

	1928	1929	Increase or Decrease, Per Cent
Production, December.....	12,189,000	11,215,000	—8
Shipments, December.....	7,384,000	5,908,000	—20
Stocks at end of Dec.....	22,918,000	23,519,000	2.6
Total production for year..	175,968,000	170,918,000	—3
Total shipments for year..	175,455,000	169,394,000	—3.5
No. of plants reporting.....	159	165	



Production, Shipments and Stocks of Finished Portland Cement, by Districts, in December, 1928 and 1929, and Stocks in November, 1929

District	Production—December		Shipments—December		Stocks at end of month		Stocks at end of November 1929*
	1928	1929	1928	1929	1928	1929	
Eastern Pa., N. J., and Md.....	2,760,000	2,479,000	1,963,000	1,323,000	5,410,000	5,176,000	4,020,000
New York and Maine.....	812,000	731,000	495,000	294,000	1,656,000	1,544,000	1,107,000
Ohio, Western Pa., and W. Va.....	1,029,000	940,000	606,000	511,000	2,861,000	3,010,000	2,580,000
Michigan	1,058,000	1,008,000	416,000	246,000	2,011,000	2,398,000	1,636,000
Wis., Ill., Ind., and Ky.....	1,683,000	1,445,000	644,000	429,000	2,736,000	2,885,000	1,869,000
Va., Tenn., Ala., Ga., Fla., and La.....	1,084,000	905,000	870,000	821,000	1,859,000	1,641,000	1,557,000
Eastern Mo., Ia., Minn., and S. Dak.....	1,269,000	993,000	359,000	273,000	2,880,000	2,595,000	1,876,000
W. Mo., Neb., Kans., Okla., and Ark.†	691,000	976,000	507,000	529,000	1,346,000	1,456,000	1,009,000
Texas	472,000	593,000	375,000	450,000	522,000	813,000	670,000
Colo., Mont., Utah, Wyo.† and Idaho†	206,000	34,000	68,000	81,000	524,000	456,000	453,000
California	909,000	913,000	914,000	813,000	696,000	1,090,000	991,000
Oregon and Washington.....	216,000	148,000	167,000	138,000	417,000	455,000	445,000
	12,189,000	11,215,000	7,384,000	5,908,000	22,918,000	23,519,000	18,213,000

Production, Shipments and Stocks of Finished Portland Cement, by Months, in 1928 and 1929

Month	1928—Production—1929		1928—Shipments—1929		Stocks at end of month	
	1928	1929	1928	1929	1928	1929
January	9,768,000	9,881,000	6,541,000	5,707,000	25,116,000	26,797,000
February	8,797,000	8,522,000	6,563,000	5,448,000	27,349,000	29,870,000
March	10,223,000	9,969,000	10,135,000	10,113,000	27,445,000	29,724,000
April	13,468,000	13,750,000	13,307,000	13,325,000	27,627,000	30,151,000
May	17,308,000	16,151,000	18,986,000	16,706,000	25,984,000	29,624,000
June	17,497,000	16,803,000	18,421,000	18,949,000	25,029,000	*27,505,000
July	17,474,000	*17,315,000	19,901,000	*20,319,000	22,580,000	24,525,000
August	18,759,000	18,585,000	21,970,000	23,052,000	19,374,000	20,056,000
September	17,884,000	17,223,000	20,460,000	19,950,000	16,799,000	17,325,000
October	17,533,000	16,731,000	19,836,000	18,695,000	14,579,000	15,381,000
November	15,068,000	*14,053,000	11,951,000	*11,222,000	17,769,000	*18,213,000
December	12,189,000	11,215,000	7,384,000	5,908,000	22,918,000	23,519,000
	175,968,000	170,198,000	175,455,000	169,394,000		

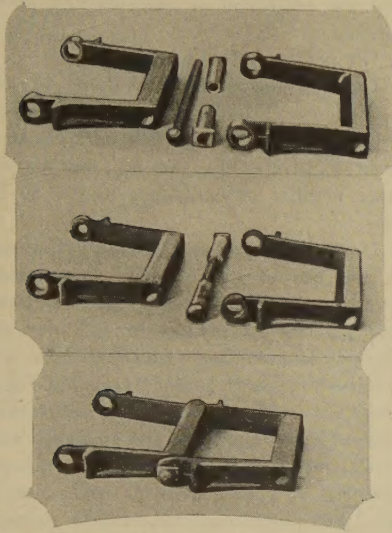
*Revised.

†The inclusion of Wyoming begins with April, 1929; of Idaho with June, 1929; of Arkansas with September, 1929.

Mill Equipment

Design of Composite Pintle Conveyor Chain

A new type of conveyor or drag chain (Brayton patent) has recently been designed and developed by the American Manganese Steel Company, Chicago Heights, Illinois, for use in handling cement clinker refuse and other material handled by drag chains.



The links are made from Manganese steel. In place of the usual steel pin or rivet running clear through the body of the link, each link of the new chain is supplied with two hollow Manganese steel bushing pins, one for each eye of the link.

Improve Design of Blasting Machines

Recent developments in blasting machine design have practically eliminated the necessity for oiling the bearings, according to an announcement of Hercules Powder Company's explosives technical service division.

Manufacturers of the one to fifty hole blasting machine have installed an armature shaft of special porous bronze, impregnated with graphite. During assembly a little oil is put on this shaft, and thereafter for the life of the machine the shaft bearing is self-lubricating. Troublesome oil cups have been eliminated, and the only oil now necessary to the blasting machine is a very small quantity occasionally applied externally to the rack bar.

The past year has marked considerable progress in blasting machine design, according to the technical service division manager, J. H. Horlick, Jr. An improved

pocket size blasting machine of the dynamo type, the first of this kind to be manufactured in the United States, was introduced in the new Hercules ten cap machine.

Electric Reciprocating Car Feeders

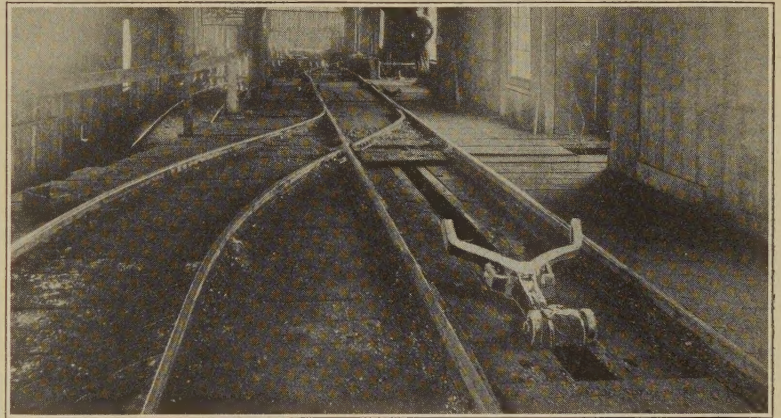
The electric reciprocating car feeder has lugs which bend and pull off, and derailment injuries to track and the wrecking of cars due to lug troubles are reduced, according to the Roberts and Schaefer Co., Chicago. The electric reciprocating car feeder has but one carriage in which there is a forked dog or duck hook, designed especially for the car, which engages the axles near the bearing wherever there is the least tendency to bend the axles. Or it engages the bearings themselves, or engages the ends of cars, depending on the type of car used.

This dog is held up by a positive spring

construction.

Operation is simple; by pushing a control button the carriage travels forward whatever distance the stroke is set for, automatically reverses and returns to its starting position and stops. It is not necessary to push any button to change its direction or stop the carriage as this is automatically done through the electrical control. Emergency buttons, however, are provided so that the carriage may be reversed at any point of the forward stroke or stopped, as desired.

In fair weather conditions when the cars are moving rather freely it may be necessary to take but a partial stroke and permit the cars to drift the remainder of the distance by themselves. In bad weather, or as the cars become old and do not move as freely, it may be found necessary to take a considerably longer stroke to deliver the cars to the point desired. A simple adjustment of the switches permits



action, insuring its engagement of the cars at all times, though it permits the passage of the locomotive over it. The carriage has a long wheel base to distribute the eccentric pull, and extra guide wheels to prevent the bending of the guides. The load is picked up against a powerful spring cushion.

The carriage runs forward and back on heavy I-beam guides mounted on cast steel supports. There are no guides required for the return strand or lower strand of chain.

Among the leading advantages of the electric reciprocating car feeder the manufacturer lists the following: No lugs required on the cars; no bending of axles; absolute control of trip at all times; adjustable length of stroke for varying weather conditions and friction of cars; fewer moving parts—less upkeep; lower installation cost; design permits heavier

making this change. Operating the car feeder by remote control from any position is possible as required.

These feeders also act as trip-makers, saving grading of track for empty holes and eliminating bumping together of cars after running a long distance down an empty siding. Construction of a knuckle over which the cars are fed is also eliminated in order to get sufficient grade so that the empties will run away.

For service as a trip-maker this electric reciprocating car feeder is started by a switch operated by the car itself as it comes off the kickback and the whole train is advanced one car length on the arrival of each car from the kickback. The car feeder therefore is not operating except when it is necessary to feed the empty trip forward to make room for the oncoming empties.

With the Manufacturers

NOTES FROM THE FIELD

Newton Joins Nordberg

Harry W. Newton, conservation engineer for the Portland Cement Association for several years, has joined the Symons Crusher Department of the Nordberg Manufacturing Company of Milwaukee, effective February 1st. Mr. Newton will be engaged in special investigations in connection with sales development.

Prior to the war Mr. Newton was in private consulting engineering work in Seattle, dealing with mining and metallurgical operations in the Pacific Northwest, in British Columbia, Alaska and Yukon Territory. During the war he was in the military service as an engineer officer, and in 1919 he became associated with the Dorr Company in special sales development work. He remained with that company until 1928, when he went with the Portland Cement Association. Mr. Newton graduated from the University of Illinois in 1905.

Santry Heads Combustion Engineering

Wilfred R. Wood and the Irving Trust Company, receivers of Combustion Engineering Corporation, New York City, have announced the appointment of Joseph V. Santry as head of that organization to succeed Col. H. D. Savage, who is assisting the receivers.

Mr. Santry, who became identified with Combustion Engineering Corporation shortly after its organization in 1914, served successively as director and vice-president in charge of sales for five years and as president for four years, resigning about two years ago.

New Allis-Chalmers Office in South

The Allis-Chalmers Manufacturing Company announces the establishment of a Chattanooga sales office at 633 Tennessee Electric Power Building.

This office, with D. S. Kerr, as representative in charge and A. I. Richardson, sales engineer, will operate as a branch of the Atlantic district office under the direction of Berrien Moore, district manager.

Munday Is Schaffer Representative

The Schaffer Poidometer Company of Pittsburgh, Pa., has just appointed H. W. Munday of 228 North LaSalle Street, Chi-

cago, Ill., as its exclusive sales representative in the entire states of Minnesota, Iowa, Wisconsin, Michigan and the northern part of the states of Illinois and Indiana for the sale of the Schaffer Poidometer and the Hydrator.

Mr. Mundy is a graduate engineer with considerable experience in the cement, lime and gypsum industries, and was formerly editor-in-chief of "Pit and Quarry"; and recently general sales manager of the Huron Industries, Inc.

Fuller Takes on Compressors and Vacuum Pumps

The Fuller Company, Catasauqua, Pa., made announcement early in January that it is now offering to the trade Fuller rotary compressors and vacuum pumps—machines designed to "appeal to users of this type of equipment on account of their simplicity of design, space required and weight for given quantity of air handled."

The staff of the engineering department has been augmented to handle this addition and literature is said to be available on the equipment.

Charles Piez Elected A. S. M. E. Head

At the annual meeting of the American Society of Mechanical Engineers held in New York City in December, Charles Piez, chairman of the board, Link-Belt Company, Chicago, began his term as president of the association. Mr. Piez is widely known as an engineer, a manufacturer and an executive.

Industrial Literature

Details of C-E Stoker

Catalog MR-2, published by the Combustion Engineering Corporation, New York, describes the C-E multiple retort underfeed stoker, Super-station type. The first page describes the stoker from an investment standpoint, followed by a numbered reproduction and corresponding descriptions of the design and construction features.

Other portions of the publication concern its building, operation, its structural features, and description and operation of the principal parts of the stoker. Varied views are included.

Explosives Review

The explosive department of E. I. du Pont de Nemours & Company, Wilmington, Del., in a review covering activities in the explosives industry during 1929 points out a number of important advances which have been made including the extension of the use of certain explosives, the development of new explosives, the progress of new methods of manufacture and the perfection of new blasting accessories.

The review states in part:

The low density Permissibles of the ammonium nitrate type are still gaining in popularity. These explosives on account of their relatively low density run a very large number of cartridges to the 50 lb. case.

There has been still further expansion in the use of the so-called low density ammonia dynamites. These were developed and put on the market in 1927 for the purpose of providing explosives more economical for use in mines where high powered, shattering explosives are not necessary. These explosives are available with stick strengths ranging from 20 to 55 per cent but vary in density or sticks per 50 lbs. depending upon the stick strength desired. For example the 20 per cent powder runs 170 sticks per 50 lbs. whereas the 55 per cent powder runs 115 sticks per 50 lbs. There are numerous mines in the country where the replacement of the old standard dynamites by these new ones has brought about an unusual reduction in the explosive cost per ton of ore.

During the past year these low density ammonia dynamites have been improved along the line of making them more cohesive which has increased the value of these explosives for use in mines where trouble is frequently encountered with the granular types of dynamites crumbling from the holes during loading.

Semi-gelatinous ammonia dynamites have just recently been developed, these dynamites being an improvement over the old standard ammonia dynamites in respect to water resistance. Just how great a field these explosives will have remains to be seen.

In the blasting supply field there continues to be a shift from the use of caps fired by means of fuse to the electric type of blasting cap. The use of tetryl blasting caps which were put on the market three years ago has become extensive and the satisfactory performance of these caps as compared with the old fashioned fulminate caps has shown that there has been a definite step in advance in the art.